STRAY MILITARY PAPERS

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BY

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Late ROYAL ARTILLERY

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NOTE

In the first chapter the word 'Musket' is frequently used to designate smoothbore small-arms in general.

In the third chapter the phrase 'Field Artillery' includes Horse Artillery and Field Batteries.

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I

INFANTRY FIRE-FORMATIONS

An Infantry fighting-formation implies a certain number of men, drawn up in a certain order specially designed to enable the men to make the best use of their weapons; the word 'order' meaning a certain number of ranks, with or without intervals between the files. The order, then, primarily depends upon the qualities of the arms in use, and the value of a fighting-formation is measured by the extent to which it admits of these qualities being utilised. This principle is exemplified in every fighting-formation of which we have any record. The Greeks armed with a spear 22 ft. long were formed in a phalanx 16 ranks deep without interval. The Roman heavy-Infantry required an interval of 3 ft. to enable them to throw their *pila*, or javelins, and rush on with the sword. The Balearic islanders re-

quired a still more open order for the free use of their slings. Now the two essential qualities of a fire-arm are, (*a*), the precision of its fire, and (*b*), the rapidity of its fire, estimated by the average number of aimed shots that can be fired from it in the ranks per min. Let us enquire how far and in what way these two qualities can influence the order of a fire-formation.

Suppose that we belong to a containing force maintaining a passive defence, and that it is our duty to hold a position of 240 paces', or 200 yards' front. Suppose further that in order to prevent the enemy from quitting his own position to storm ours, it is necessary for us to be able to make 6 hits per min. along our front. Suppose finally that our men are armed with a musket from which 2 aimed shots can be fired per min., and whose precision is such that, at the distance of the enemy, we may expect 1 bullet in 20 to hit,—or shortly, whose measure of precision (at this range) is $\frac{1}{20}$. On these suppositions, and without taking the men's skill in shooting into account, how many men are required to hold our front? We obviously require 60 men in single rank, at 3 paces' interval. For since the rapidity of fire is 2 shots per min., these 60 men can

fire at the rate of 120 rounds per min.; and since the measure of precision is $\frac{1}{20}$, 6 of these 120 bullets will hit. Let us now observe the consequences of varying the measure of precision, the rapidity of fire remaining the same, 2 shots per min. With a precision of $\frac{1}{30}$, we should require 90 men in single rank, at 2 paces' interval, to produce the same effect; and 120 men, at 1 pace interval, with a precision of $\frac{1}{40}$. With a precision of $\frac{1}{100}$, we must occupy the front with the 300 men it will just contain in single rank, shoulder to shoulder (allowing a front of 2 ft. per man). Were the precision $\frac{1}{200}$. we should have to employ the British line, 600 men in 2 ranks; and a precision of $\frac{1}{300}$ would throw us back upon the fire-formation of Frederic the Great, 900 men in 3 ranks.

Let us now adopt a constant measure of precision of $\frac{1}{100}$, and observe the consequences of varying the rapidity of fire. With a rapidity of $\frac{2}{3}$ shots a min.[1] we have the order of Frederic; with a rapidity of 1 shot a min. we return to the British line; and so on, as shown in Table A.

The reader is requested to bear in mind that the numbers in cols. 3 and 4 of Table A. do not

[1] *i.e.* 2 shots in 3 minutes.

profess to represent the actual precision and rapidity of *any* small-arm at *any* period. The object of the Table is not to set forth the qualities of fire-arms at various times, but to show how the number of men required to occupy a given front, under fixed conditions, varies, first when the precision of their arm varies, and secondly when its rapidity varies. To illustrate this, those numbers were chosen which lead to simple calculations, and thus enable an obscure and complicated matter to be put in the clearest light. *Any other numbers* would lead to conclusions precisely similar to those I am about to point out.

TABLE A.—*Showing the variations in the number of men required to hold a given front, when the precision and rapidity of the fire-arm vary.*

Conditions.				Fire-Formation.			Periods at which Fire-Formations similar in form were used.
Length of Front.	Hits to be Made.	Precision of Arm.	Rapidity of Arm.	No. of Men required to occupy the Front.	No. of Ranks.	Interval between Files.	
Paces.	Per Min.		Per Min.			Paces.	
240	6	$\frac{1}{20}$	2	60	1	3	Franco-German War and French Revolution.
,,	,,	$\frac{1}{30}$	,,	90	1	2	
,,	,,	$\frac{1}{40}$	,,	120	1	1	
,,	,,	$\frac{1}{100}$	,,	300	1	0	
,,	,,	$\frac{1}{200}$	,,	600	2	0	Peninsular War.
,,	,,	$\frac{1}{300}$	,,	900	3	0	Seven Years' War.
,,	,,	$\frac{1}{100}$	$\frac{2}{3}$	900	3	0	
,,	,,	,,	1	600	2	0	Peninsular War.
,,	,,	,,	2	300	1	0	
,,	,,	,,	5	120	1	1	French Revolution and Franco-German War.
,,	,,	,,	8	75	1	2	
,,	,,	,,	10	60	1	3	

This purely hypothetical Table shows in what way and how far the progress of small-arms influences fire-formations. As fire-arms improve, the number of men required to occupy a given front diminishes.[1] The ranks first gradually decrease to their *minimum*, one, and lateral expansion then begins. The limit to the reduction in the number of men is assigned by the *moral* of the men. Men who would fight stoutly in 3 ranks might not be reliable in 2 ranks, as Frederic the Great and Napoleon well knew: men who are trust-worthy when shoulder to shoulder might not be steady in open order.[2] The Table further shows that the transition from the order of the Seven Years' War to that of the Franco-German might have been caused either by an increase in the rapidity or in the precision of fire-arms, or by an increase in both; had these causes acted alone, undisturbed by other forces. But the abrupt change in continental armies from the order of Frederic to that of the French Revolution, is explicable by no mere improvement in arms; for

[1] "Le feu . . . rendant la profondeur des bataillons inutile, diminua insensiblement le nombre des rangs et augmenta son front." —"Hist. de mon Temps," Frederic the Great; Leipsig, 1879; p. 201.

[2] Duhesme's "Essai Historique sur l'Infanterie Légère," Paris, 1864; avant-propos, p. xi.

none took place of sufficient importance to warrant such a change. The necessary inference is that the natural development of fire-formations may be hindered and distorted by influences totally unconnected with the qualities of the arms in use. To ascertain the nature of these influences, and when and how they operated, we must appeal to Military History. The reader may perhaps smile at being carried back to the Thirty Years' War; but let him rest assured that the Art of War does not date its birth from 4th August 1870. The Franco-German War was but one (and by no means the most important) scene in the 'bloody and impassioned drama;' and we can no more understand the principles of its fire-tactics without a knowledge of previous campaigns, than we can understand the plot of a Play by witnessing the last Act only.

In the 16th and 17th centuries a body of musketeers could deliver their fire in (at least) three ways. Suppose the formation to be 10 ranks deep. If the files were closed, the first 9 ranks knelt down and the 10th fired and reloaded; the 9th rank rose, fired and reloaded; and so on. By another method, the 10th rank faced outwards from the centre, filed round the

flanks, reformed (flank files in the centre) in front of the 1st rank, fired and reloaded; and so on. Or the 1st rank fired, faced outwards from the centre, filed round the flanks, reformed in rear of the 10th rank, and reloaded; and so on.[1] By a third method, if the files were closed, the command was given, "Open your Files"—generally to 3 ft. interval. On this being done, either the files of the 10th rank passed through the intervals to the front, fired and reloaded, and so on; or the 1st rank fired, passed by files through the intervals to the rear and reloaded, and so on. In order to cover the front by a continuous fire, the number of ranks had to be so chosen that the rank which fired first was reloaded and ready to fire again when all the other ranks had fired. This was the fundamental principle of all early fire-formations. Montluc says that at the siege of Lens, 1552, he observed that 10 ranks were the exact number of ranks required.[2] Writing in 1670–1, Sir James Turner says "five ranks of musketeers

[1] These two modes of firing lingered on in the French service until the Revolution, and were very properly denounced in the excellent article, 'Feu,' "Encyclopédie Méthodique," Paris, 1785.

[2] "Commentaires de Messire Blaise Montluc," Paris, 1821; ii. 98. The precision was quite in keeping with the rapidity of the arquibus. "Telle fois ay-je vu tirer mil arquibusades à cent pas de moy, sans estre offensé!"—Ibid., p. 92.

can fire one after another without intermission, and the first of the five be ready to fire again before the last have discharged."[1] In a century and a quarter, therefore, the number of ranks necessary to maintain a continuous fire had fallen from 10 to 5; or, the rapidity of fire was doubled.

When Gustavus Adolphus came to the throne he shortened the musket from 6 ft. to 5 ft.; lightened the bullets from 10 to 13 to the lb.; and introduced paper cartridge-cases for the powder.[2] These changes considerably increased the rapidity of fire, and improved its precision by ensuring the use of the proper charge of powder for each shot. But the weakness of the fire, even still, is proved by the use of the 'Swedish feathers' by the defensive force, a rude *chevaux-de-frise* of wooden stakes, such as had been used by our archers two centuries earlier.[3]

[1] "Pallas Armata," London, 1683; p. 170.

[2] Composite cartridges, although not in general use, were known in England years before the time of Gustavus; for Sir John Smythe speaks of "cartages with which (musketeers) charge their peeces both with powder and ball at one time."—"Certain Discourses . . . concerning divers Weapons," London, 1590; p. 20.

[3] Speaking of Talbot's overthrow, Shakespeare says:—

"No leisure had he to enrank his men;
He wanted pikes to set before his archers;
Instead whereof sharp stakes, pluck'd out of hedges,
They pitchèd in the ground confusèdly,
To keep the horsemen off from breaking in."

—1 *Henry VI.*; i. 1.

The rapidity of fire was less than that of the Battalion guns, one of which could fire 4 rounds while a musket was firing 3 shots.[1] This was inevitable from the state of the ammunition. The charge of powder had to be poured loose into the barrel from (the horn or) the cartridge-case; the ball had to be put in, and after it the wad; the charge had then to be rammed home; the priming had to be poured into the pan; the match had to be 'blown up' and fixed in the cock; and the musket roughly aimed and fired. Aiming, in *our* sense of the word, was hardly practicable, owing not so much to coarse and faulty sights[2] as to the clumsy and cumbersome stock. With the straight Spanish stock some attempt at correct aiming could be made, but this was out of the question with the curved French stock. "Were (the muskets) stocked crooked, to be discharged from the breast, fewe or none could abide their recoyling; but being discharged from the shoulder (if they be straight stocked) there is neither danger nor hurt."[3]

[1] Rüstow's "Geschichte der Infanterie," Leipsig, 1884; ii. 37.

[2] Major Schmidt of the Swiss Army gives a sketch of a fire-arm, dated 1500–1510, with fore and hind sights, in his "Handfeuerwaffen," Basil, 1875; p. 11.

[3] Williams' "Brief Discourse on War," 1590.

Feeble as was the effect of musketry now, the rate of fire was so much quicker than in Montluc's time, that Gustavus Adolphus reduced the ranks from 10 to 6 deep, and for the final attack to 3 deep. His Brigade of 432 musketeers[1] and 576 pikemen was subdivided into 3 Squadrons of 144 M. and 192 P., each in 6 ranks, with a front of 3 ft. per man. The 144 M. were again subdivided into 6 corporalships of 4 files, or 24 men, with an interval, or lane, of 4 ft. between each. The front of 96 ft., therefore, occupied by the 24 files M. (including 4 lanes of 4 ft. and a 5th lane of 8 ft. between the two centre corporalships) was exactly equal to the front of the 32 files P. behind whom the musketeers took refuge in case of emergency. But a front of 96 ft. can just contain 48 men at 2 ft. per man. Therefore by opening the files of the musketeers to a 2 ft. interval, there was just room to double the number of men in the odd ranks, by the men of the even ranks stepping forward into these intervals; the whole 144 M.

[1] His Regiment contained 216 additional M., posted among the Cavalry. The word 'Regiment' is much older than Grose supposed it to be,—a century old in his time (1786); "Mil. Antiquities, &c.;" i. 242. It occurs with its present meaning in Richard III.; v. 3, and in K. John; ii. 1 (written before 1598); and again in Ant. and Cleop.; iii. 6, with its older meaning of 'sway' or 'dominion,' in which it is used by Peele, Greene, and Spenser.

then standing shoulder to shoulder in a line of 48 files, 3 deep, without any extension of their original front. To effect this change, the word of command was, "To the left (or right, of the files of the odd ranks), double your ranks!"[1]

To advance firing with close intervals (6 ranks), the files of the 6th rank moved to the front through the lanes, reformed in front of their respective sections, fired and reloaded; and so on. If an attack was resolved on, the line was halted, the command 'double your ranks' was given, and some salvos were fired, the front rank kneeling, the second stooping, and the third rank standing. But as Turner says, this was only intended "for a parting blow," three ranks not being "numerous enough for musketeers to fire one rank after another without interruption."[2] After the volley, the musketeers took refuge behind the pikes and, as a general rule, the Cavalry charged.

The Brigade corresponded generally to our Battalion. The rapidity of fire (exclusive of miss-fires and hang-fires) was presumably about 2 shots in 3 mins.

[1] "Munro his Expedition with the Scots Regiment, &c.," Maj.-Gen. Monro, London, 1637. The ordinary intervals (and distances) were 1½, 3, and 6 ft.

[2] "Pallas Armata;" p. 217.

The first great step in fire-formations, then, was taken by the Swedish King chiefly, if not entirely, in consequence of an increase in the rapidity of fire-arms.

In the middle of the Thirty Years' War the Great Rebellion broke out in England, and at the beginning of it was made the last serious effort to raise a body of archers in Europe. In 1643 Charles I. issued a proclamation in which archers are mentioned, and Essex ordered the formation of a company of archers.[1] What were the relative advantages of the musket and bow at this period?

In so far as simplicity of construction, cost, and weight were concerned, the advantages were all on the side of the bow. The bullet was less deflected by wind than the arrow; but on the other hand it was exceedingly difficult to pour the priming into the pan in a high wind. The bow-string could be easily protected against rain,[2] which might render the musket entirely useless by extinguishing the match or drowning the priming.

[1] "Encyclopædia Britannica," Art. "Archery."

[2] At Crécy the bows of the English archers "were kept covered in their cases during the shower" that preceded the battle. Barnes' "Hist. of that most triumphant monarch, Edward III.," Cambridge, 1688; pp. 356–8. See Ascham's "Toxophilus," 1821 (1st ed. in 1571); p. 67.

Thus at Uddevalla in Sweden, 1677, the battle was fought with *armes blanches*, a prolonged storm of rain having put a complete stop to firing.[1] With regard to ammunition, the musketeer could carry more bullets than the archer could carry arrows. But a single archer, drawing to his ear, could shoot at least twice as fast as a musketeer;[2] and if we take two bodies of 100 men each, 'digested in 10 ranks' (as Capt. Bingham says), the one armed with bows, the other with muskets, the archers (who could shoot all together) could discharge 200 arrows against the 20 bullets fired in the same time by the first two ranks of the musketeers.[3] The effective range of the bow was greater than that of the musket. Brown Bess, a better weapon than the musket of the Great Rebellion, was not reliable beyond 200 yds., while the ordinary ranges at which archers were compelled by law to practise lay between 200

[1] Crichton and Wheaton's "Scandinavia;" p. 109.

[2] That is, in the beginning of the 17th cent. With the early fire-arms, 36 arrows and 3 bolts from the crossbow could be shot for one bullet. Major Jähn's "Handbuch der Gesch. des Kriegswesens," Leipsig, 1880; p. 759.

[3] "The Tacticks of Ælian," trans. by Capt. J. Bingham, 1616; p. 26. Sir John Smythe's "Certain Discourses . . . concerning divers sorts of Weapons," London, 1590,—an attack on fire-arms. H. Barwick's "Brief Discourse concerning Weapons of Fire," London, 1594,—a defence of fire-arms, in reply to Smythe.

and 400 yds.[1] In accuracy the two weapons were much on a par, both being inferior to the cross-bow; but even here, probably, the superiority lay with bow. In a match shot on Pacton Green, Cumberland, in 1792, 20 shots each at 100 yds. range, the bow won with 16 hits, the musket only scoring 12;—an inconclusive trial, no doubt, but the only one I am acquainted with.[2] In penetration there was no comparison between the two weapons. The arrow glanced harmlessly off armour which was unable to resist "the furie of the fire-shot."[3] The musket, too, was better adapted for general use, inasmuch as "the weakest (might) use guns as well as the strongest," whereas "your lusty and strong yeomen were chosen for the bow."[4] Further, "the bow (required) more

[1] In Ed. IV.'s time; "Encyc. Brit.," art. 'Archery.'

"He drew a good bow . . . he would have clapped i' the clout (bulls-eye) at twelve score" (240 yds.); 2 Henry IV.; iii. 2.

An old German writer said in 1675: "Auf sechshundred und zwantzig schritt befunden wihr, dass die kugel kein kraft mehr hatte."—Thierbach, "Gesch. Ent. d. Handf.;" p. 26.

[2] Greener's "Gun, &c.," 6th ed.; p. 12.

[3] "Four Paradoxes," T. Digges, London, 1604; p. 62. With the early small-arms, however, the contrary was the case. "Wir wissen dass die Pfeile der englischen Bogenschützen des Mittelalters Panzer durchbohrten, von denen die Geschosse von Handfeuerwaffen wirkungslos abpralten."—Romocki's "Gesch. der Explosivstoffe," Berlin, 1895; i. 56.

[4] Barnes' "Hist. Ed. III.," as before quoted. At the same time, Ascham reminds us that "drawing stronge lyeth not so much in the strength of men as in the use of shootinge."—"Toxophilus;" p. 106.

practice to skilful use than any other instrument of offense."[1] The fire-arm, in fact, "though it by no means put the awkward upon a level with the skilful, put him more nearly so than he ever was before."[2] This brief statement of the case may explain why as late as the American War of Liberation, Benjamin Franklin was advocating the revival of archery.[3]

Since the early years of the 16th cent. the match-lock, in which the priming was ignited by the direct application of a lighted match, had had a rival in the wheel-lock, in which the spark was obtained by means of friction between a notched wheel, revolving rapidly, and a piece of iron pyrites.[4] A rival to both locks appeared about the middle of the century in the flint-lock, in which the spark was obtained by the percussion of a flint and steel. It was called at first the snaphance (Dutch, *snap-haan* = snap-cock), a term applied indifferently to the lock and the weapon. There is a specimen of this lock in the possession

[1] Dr. Johnson on Ascham's "Toxophilus;" Works, iv. 654.

[2] Adam Smith's "Wealth of Nations;" ii. 191.

[3] Franklin's Works, ed. by Sparks; p. 169.

[4] The first wheel-locks were made in Nürnberg, 1515. See Jähn's "Geschichte des Kriegwesens," Leipsig, 1880; p. 1203. Montaigne in his 37th Essay, published in 1580, speaks of wheel-lock pistols as well-known weapons.

of Graf Erbach zu Erbach at Odenwald dated 1500–20;[1] but "the earliest real flint-lock" in England is the snaphance numbered $\frac{12}{79}$ in the Tower Armoury, dated 1614, made for Charles I. when a boy.[2] The snaphance, however, must have been well known to the English public long before the end of the 16th century; for it is mentioned in Lilly's "pleasant conceited comœdie, Mother Bombie," published in 1594.[3] No popular dramatist would have ventured to bewilder his audience by alluding to a fire-arm they had never heard of. The flint itself, as well as the match, is mentioned in Beaumont and Fletcher's burlesque, "The Knight of the Burning Pestle," 1611, which gives us a glimpse of the 'Inspection of a Company' in those days:—

"*Ralph, the Commander.*—Open your files that I may take a view both of your persons and munition. Sergeant, call a muster.

Sergeant.—A stand! William Hamerton!

Ham.—Here, Captain!

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[1] Thierbach's "Gesch. Entwickelung der Handfeuerwaffen," Dresden, 1886; p. 52.

[2] Hewitt's "Ancient Armour, &c.;" iii. 711. The snaphance has been traced back in English documents to 1588.

[3] Act ii. Sc. 1. Mother Bombie was a celebrated 'wise woman.'

Ralph.—A croslet and a Spanish pike. 'Tis well; can you shake it with a terror?

Ham.—I hope so, Captain.

Ralph.—Charge upon me:—'tis with the weakest! Put more strength, William Hamerton, more strength! As you were again! Proceed, Sergeant.

Sergt.—George Greengoose!

Green.—Here!

Ralph.—Let me see your peece. . . . There is a main fault in the touch-hole. . . . Get you a feather, sweet oil and paper, and your peece may do well enough yet. Where is your powder?

Green.—Here.

Ralph.—What! in a paper? As I am a soldier and a gentleman, it craves a martial court: you ought to die for it! Where's your horn? Answer me to that!

Green.—An't like you, Sir, I was oblivious.

Ralph.—It likes me not it should be so; 'tis a shame and a scandal . . . to leave your horn behind you. . . . Where's the flint of this peece?

Soldier.—The drummer took it out to light tobacco.

Ralph.—'Tis a fault, my friend; put it in again. . . . Remove and march! Soft and fair, gentlemen, soft and fair! Double your files! As you were! Faces about! Now, you with the sodden face, keep in there! Look to your match, sirrah! It will be in your fellow's flask anon!"[1]—*Act* v. *Sc.* 1.

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[1] Accidents sometimes did happen in this way. "A soldier's bandalier (who guarded the colours) took fire and went off in a heat, which made an incredible confusion among us."—Gwynne's "Mil. Memoirs of the Great Civil War;" p. 41.

The wheel-lock was more costly and complicated than the snaphance, but it held its ground for many years for a reason given by Colonel Harwood in a Memorandum written for Charles I. :—"The fire-lock (wheel-lock) is more certain for giving fire, the (snaphance) more easy of use."[1] Both were superior to the match-lock; yet the wheel-lock, I believe, was never, and the snaphance was only occasionally the recognised arm of the service. Repeatedly forced into the service by able men, the original snaphance was as often forced out of it by ignorance and prejudice, and replaced by the ancient matchlock. But in the close of the century the stupid party were borne down by a Dutch King, Dutch Generals, and the strain of war. A modified snaphance then supplanted both the old fire-arms, with an improved lock which diminished the missfires, and a more shapely stock which enabled the men to take better aim. But notwithstanding these improvements, troops armed with the fusil, as the improved snaphance was generally called, could not have dispensed with the protection of pikemen had not another arm, long and inexplicably overlooked, now come into prominent notice—the bayonet.

[1] Harleian Miscellany; iv. 275.

For years the minds of soldiers had been disturbed by the helpless condition of musketeers when actually attacked by other troops. If they had no pikemen, as sometimes happened, or if their pikemen were not at hand and the enemy seized the opportunity to come to close quarters, the musketeers were practically defenceless. Writing in 1639 Colonel Bariffe says:—"In several parts of Christendom divers Captains and Souldiers have oft been trying conclusions to make the musketiers as well *defensive* as *offensive:* some by unscrewing the heads of their rests, and then screwing the staff of these rests into the muzzle of the musket, &c., &c."[1] Bariffe himself wholly failed to grasp the situation, and proposed to give the Infantry half-pikes as a remedy, in addition of course to their muskets.

The first (known) mention of the bayonet occurs in the Memoirs of Seigneur de Puységur, Paris, 1747. He tells us there that in 1647, when commanding the troops at Ypres, &c., his musketeers used bayonets consisting of a steel dagger, fixed in a wooden haft which fitted into the muzzle of the musket, — in fact, plug-bayonets.[2] In the

[1] "Military Discipline," 6th ed., London, 1661; p. 145.

[2] "Les Mémoires de Messire Jacques de Chastenet, &c.;" ii. 306. Thierbach mentions a letter written in 1575 alluding to a dagger

years 1663–4, there were Courts-Martial held at Tangier on men for making use of their daggers on their comrades. This fact, by itself, suggests nothing further; but combined with the two facts, that bayonets were at first called 'daggers' and that there were few or no pikemen in Tangier until about 1675, it points to the probable conclusion that our troops in that garrison used plug-bayonets at this time.[1] Nothing more is heard of the bayonet until the year 1671, when bayonets of this kind were issued to the companies of the French Fusiliers then first raised.[2] Part of an English Regiment of Dragoons, raised in 1672 and disbanded in 1674, was armed with similar bayonets,[3] and the Royal Fusiliers were supplied with them when raised in 1685.[4] The great and actual danger of not being able to fire when this bayonet was fixed, was felt of course from the first; and the Marquis de Puységur says that already in 1678 he saw a bayonet with rings which could be fixed without stopping

called a bayonet; but the authenticity of this document is at least doubtful. "Gesch. Entwickelung d. Hand.;" p. 83.

[1] See Col. C. Walton's "Hist. of the British Standing Army," p. 344; an admirable fragment which its author, unhappily, did not live to complete.

[2] Rüstow, ii. 183. [3] "Hist. Record, K. D. Gs."

[4] "Records of the Royal Regt. of Fusiliers."

the fire.[1] The use of the word 'Fusilier' by Hammer makes it almost certain that the bayonets used at the siege of Buda in 1686 were plug-bayonets;[2] and it is quite certain that the defeat of the Royal troops at Killiecrankie in 1689 was to some extent due to the defects of a bayonet which screwed into the muzzle of the musket. "The Highlanders are of such quick motion," says the defeated General, "that if a Battalion keep up his fire till they be near to make sure of them, they are upon it before our men can come to the second defence, which is the bayonet in the musle of the musket." In consequence of this, Gen. Mackay "invented the way to fasten the bayonet to the musle without, by two rings."[3] Plug-bayonets begin to be shown in our Ordnance Stores (by thousands) in 1691, and a large part, if not all, of our Infantry used snaphances with sword-plug-bayonets in the wars of William III.[4] During these wars Louis XIV. refused to discard the pike entirely, owing to the result of a trial of socket-bayonets made in his presence shortly

[1] "Art. de la Guerre;" i. 220.

[2] "Hist. de l'Empire Ottoman," trans. by Hellert; xii. 200.

[3] Mackay's "Memoirs of the Scottish War," Edinburgh, 1833; p. 52.

[4] Walton's "Hist. Brit. Stand. Army;" p. 349.

after the battle of Fleurus, 1690;[1] but says Puységur, "peu de temps après (*i.e.* shortly after the peace of Ryswick, 1697), des Nations contre lesquelles nous avons été en guerre quittèrent les piques pour prendre les fusils avec les bayonnettes à douille."[2] This thoroughly corroborates the statements of Grose, who vainly sought "the precise time when bayonets of the present form (*i.e.* socket) were first adopted here,"[3] but who proves satisfactorily that the pike was suppressed in the English army between 1690 and 1705. In this latter year the pike was spoken of as "a weapon formerly in use." Marlborough would not have risked the danger of abolishing the pike altogether, had not our Infantry been armed with a bayonet that could be fixed without stopping their fire. We may take it, then, that our Infantry had the socket-bayonet in his wars. In France the stupid party, headed by d'Artagnan, an officer of the Guards, made a stout resistance to the abolition of the pike; but Vauban interposed his great influence, the pike was finally abolished in 1703 by Royal

[1] Walton's "Hist. Brit. Stand. Army;" p. 349.

[2] "Art. de la Guerre;" i. 72. England, of course, is included among these 'Nations.'

[3] i. 162.

decree,[1] and socket-bayonets were adopted "pour pouvoir tirer avec la bayonnette au bout du fusil."[2]

The introduction of the bayonet marks the end of mediæval and the beginning of modern war. Possessing the defensive properties of the pike, it drove this weapon from the field; turned the pike-men into musketeers; increased the volume of fire; and gave rise to new formations of which those now in use are only developments. Tactics were revolutionised by a dagger some 12 ins. long, attached to the muzzle of the musket.

The advance made in both rapidity and precision by the improved snaphance, or fusil, or Brown Bess, soon produced the inevitable result—the 6 ranks of Gustavus Adolphus fell first to 5, and during the war of the Spanish Succession to 4 ranks.[3] The absence of the pikemen naturally led to a suppression of the Swedish intervals. First, the intervals were no longer required to 'double the ranks' of the 4 deep line; for the most reckless tactician of the day would have shrunk from the use of a 2 deep fire-formation. Secondly, the intervals were dangerous. In the Thirty Years' War the musketeers, when threatened by

[1] Rüstow, ii. 185. [2] Puységur, ibid. [3] Rüstow; ii. 192.

a charge of either horse or foot, took refuge behind their pikes: *now* they had to bear the brunt of the attack themselves. It was, therefore, necessary to close the intervals, which not only weakened the effect of the fire, but offered gaps to the enemy to penetrate the line. The immediate effect of the suppression of the intervals was to incapacitate the 4th rank from firing. Why it was for a moment retained, it is difficult to say; but the necessity for a better fire-formation soon made itself felt, and first of all in France. "En entrant en campagne (1701), la plus grande partie de l'Infanterie se mettoit en bataille sur quatre rangs, le reste sur trois. . . . Vers la fin de la campagne il en restoit toujours très peu sur quatre."[1]

When Frederic the Great came to the throne he found that the fire-formation of his Infantry was a 3 deep line, and that their fire was much more rapid than that of any other Infantry, partly owing to the iron-ramrod and other improvements in the loading apparatus introduced by Prince Leopold of Anhalt-Dessau. It was with justifiable pride that the King said:—"Un bataillon prussien devint une batterie ambulante . . .

[1] Puységur's "Art de la Guerre," i. 57.

la vitesse dont il charga produisit un feu . . . qui, triplant de vitesse le feu de toutes autres troupes, donna aux Prussiens la supériorité de trois contre un."[1] The King gives merely the relative rapidity of fire of the Prussian and other armies. Col. Thierbach assures us that the absolute rapidity of the Prussian fire was 6 shots a minute.[2] Now an English officer, writing before the French Revolution, says that he frequently counted from 90 to 130, "with moderate rapidity," whilst an English platoon was loading.[3] If the reader make the experiment, he will find that it takes about ½ min. to count 90. The platoons in question, therefore, took ½ to ¾ min. to load. H. Beaufoy, "a Corporal of Riflemen," says the time of loading a rifle at the beginning of the present century was "a minute and a half or two minutes;" and adds that a musket could fire 3 shots in the time a rifle fired one.[4] This

[1] "Hist. de mon Temps," Leipsig, 1879; p. 201.

[2] "Die Geschicht. Ent. d. Handf.;" p. 92.

[3] "Letter from an Officer to his friend upon the methods of training Infantry for Action;" p. 7 (in Library of R. U. S. I.). The title-page is wanting, but a reference to the Potsdam Regulations leads me to think this brochure was written before the French Revolution. We had iron ramrods at this time.

[4] See his "Scloppetaria," 1808; p. 18,—a very clever book. His rifle was no doubt the Baker rifle, loaded by means of an iron ramrod and a wooden mallet.

gives an average of about 2 shots per min. as the rate of fire with Brown Bess. Lieut.-Colonel W. Handyside, late R.A., speaking from personal experience, says that "2 rounds a minute was smart work, and could only be kept up for a short time; for the pan fouled from the priming and got greasy, so that the flint missed fire. . . . The barrel got foul, too, and made the ramming more difficult."[1] The Marquis de Chambray gives us further details. "With the French flint-musket," he says, "one miss-fire might be expected in every nine shots, and one hang-fire in every eighteen. The flint had to be changed every thirty shots."[2]

How are we to reconcile the English evidence just produced with the statements of the King, which are above suspicion? There can be no doubt as to the fact that the rapidity of the Prussian fire *was* greater than 2 shots a minute. But this extreme rapidity cannot be explained by any natural capacity of Prussians to fire faster than other nations; for, as the King himself informs us, one half the Infantry of the Prussian army at

[1] Private letter.

[2] "Mémoire sur le Fusil de Guerre, &c.," Œuvres, v. 292. Wellington ordered every man to be supplied with 3 flints before landing in Portugal, August 1808.

that time were foreigners.[1] Nor can the slowness of the English fire be accounted for by assuming a natural incapacity in the English to fire with due rapidity. "Il est à remarquer," says Count Duhesme, "au sujet de cette colonne foudroyante des Anglais (à Fontenoy) . . . que cette nation avait, dans ce temps-là, la supériorité du feu sur nous. Les Anglais savaient tirer par divisions et par bataillons avec un ordre et une précision admirables."[2] Again, in the time of the Peninsular war, Baron de Marbot says that the English infantry fire was "infiniment superieur à celui des fantassins des autres nations."[3] The conflict of evidence we are considering is only apparent, and arises from a want of accuracy of expression. The English witnesses were speaking of properly aimed fire; the rapid Prussian fire was *of necessity* unaimed fire. Guibert is decisive upon this point. "(Les Prussiens) chargent à la hâte et sans bourrer.[4] . . . Le feu de l'Infanterie prussienne

[1] "Nos régimens sont composés moitié de gens du pays, moitié d'étrangers."—"Instruction Militaire, &c.," Œuvres, iii. 234. "L'Infanterie prussienne . . . est composée de toutes les nations et de toutes les religions de l'Europe."—"Observations sur la constitution militaire . . . des armées de S. M. Prussienne," by Guibert; 1777; p. 136.

[2] "Essai sur l'Infanterie légère," p. 51.

[3] "Mémoires, &c., de Baron Marbot;" ii. 391.

[4] "Essai générale de Tactique," Paris, 1804; p. 100.

. . . est trop vif pour être bien ajusté; c'est le moins meurtrier de l'Europe."[1] The Prussian Infantry could do much, and did do much that redounded to their credit; but they could not work impossibilities. No Infantry could fire more than 2 aimed shots a minute from Brown Bess.[2]

We know very little about the absolute precision of Brown Bess. Benjamin Robins found that when fired from a rest, 15 out of 16 bullets from this musket struck a square target of $1\frac{1}{7}$ ft. side at 60 yds. range.[3]

The following Table, B., will enable the reader to form some notion of the state of musketry in the latter half of the 18th century, and of the progress in shooting made in Germany in half-a-century:[4]—

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[1] "Obs. sur la const. mil., &c.;" p. 140.

[2] There seems to be a certain rapidity of fire at which Infantry soldiers make the best shooting. Numerous and careful observations show that Italian soldiers fire better at 3 or 4 shots a minute than at a slower rate; and there is an unmistakable ("molto sensibile") falling off in effect as the rapidity rises from 4 to 8 shots a minute. See Maj. B. Lorenzo's "Tiro di guerra della Fanteria," Rome, 1894; p. 12. It has been similarly observed that good billiard-players when making a break have a certain rate of play,—varying of course with individuals.

[3] "New Principles of Gunnery" (1742), Hutton's ed., 1805; p. 150.

[4] Thierbach's "Die Gescht. Entwickelung d. Handfeuerw.;" pp. 115, 155. I have taken the 'schritt' as equal to 68 cms. or 27 ins.

TABLE B.

1780.			1835.		
No. of Rounds.	Percentage of Hits.	Range.	Range.	Percentage of Hits.	No. of Rounds.
		Yds.	Yds.		
36	60	75	72	98.8	360
...	...	...	108	69.8	341
24	40	150	144	66.0	552
...	...	...	180	44.0	828
15	25	225	...	...	...
12	20	300	...	...	...
Target 100′ × 6′.			Target 6.5′ square.		

On the close of the Seven Years' War the mania for imitation, to which the military world is ever a ready prey, broke out with great violence. "L'exercise prussien," says Captain Jacquinot de Presle, "les manœuvres &c. furent imités et même calqués plus ou moins en Europe, sans égard à tout ce que le caractère national et le mode de recrutement devaient y apporter de différence."[1] With soldiers in such a temper one might have expected that the fire-formation and long, rigid

The practice of 1780 was not carried on by recruits, but by ordinary soldiers.

[1] "Cours d'Art et d'Hist. Militaires," Saumur, 1829; p. 90.

lines of Frederic would have held their ground until some signal improvement in small-arms necessitated a change. No improvement of any importance, however, took place at the time in question,—no improvement, in fact, great enough to produce a change in fire-formations took place for half a century afterwards; yet the wars of the Revolution had hardly broken out, ere the French cast to the winds the whole system of the great King. How came this about?

Shortly after the outbreak of the Revolution, the French found themselves face to face with half Europe under well-nigh desperate circumstances. They were "without armies, without generals;" and what troops they had were "unappointed, undisciplined, mutinous . . . men who never saw fire; the old generals and officers gone over the Rhine."[1] The great question was, how were men to be procured? There was one only way of getting them at once in sufficient numbers, and this method was instantly adopted. On the 20th August 1793, Universal Conscription was introduced into France. The raw levies arrived, but there was neither time nor opportunity to discipline and drill them. It was necessary, there-

[1] Carlyle, "French Revolution;" ii. 289.

fore, once for all to abandon the old tactics; for their chief characteristics were the movements and fire of long lines,[1] and the fire and movements of long lines demands the highest discipline and the most accurate drill. What order and formation, then, were the French to adopt? In physique there was little to chose between the conscripts and their adversaries. In the purely military qualities, such as drill, discipline, &c., the French were hopelessly inferior; but their *morale* was superior to that of the Austrians and Germans, and in intelligence (owing to the conscription) they were superior to any troops in Europe. It was clear, then, that the French must adopt some tactical system which, while it would enable them to derive the fullest advantage from their intellectual superiority, would screen as far as possible their inferiority in drill and discipline.

The line requires considerable discipline and drill; the column requires less of either than any known formation. The French, then, must select some form of the column formation. The columns, too, must be small; for heavy columns would suffer from the enemy's Artillery, and

[1] See some excellent remarks in "Militärische Gedanken und Betrachtungen über den deutsch-französischen Krieg, 1870–71;" p. 225.

would check the natural *élan* of the conscripts. But how to utilise the superior intelligence of the conscripts? The columns, however small, must suffer to some extent from the enemy's Artillery, and their own musketry fire was a *minimum* They could not, consequently, be brought into contact with the enemy until the edge of his fire had been blunted. How was this to be done? By making large use of an order with which many French officers were well acquainted, an order used by the Americans when fighting for their independence—skirmishing, or open order.[1] Open order was of all others the best adapted to utilise the superior intelligence of the French; it was admirably suited to their national impetuosity; and it was the only known means of covering the advance of the small columns.

By some such reasoning the French arrived at their new formation,—a fire-formation of skirmishers, followed by lines of small columns intended to break through the enemy's line with the bayonet, or by sheer weight. Under the

[1] "L'instruction dont les troupes ont besoin pour combattre en lignes déployées ou en colonnes n'étant pas nécessaire pour combattre en tirailleurs, ce dernier genre de combat était très-favorable à l'Infanterie républicaine."—Chambray, "Des Changemens survenus dans l'Art de la Guerre, &c.;" Œuvres, v. 225.

circumstances of the case the system was an inevitable makeshift; but tactically it was worthy of no praise, still less of imitation. The columns were a return, in principle, to the Greek phalanx: the fire-formation was an anachronism. The fire of the musket was too feeble, the time of loading was too long (and remained too long for another half century) to justify any very extensive use of skirmishers. But these facts were overlooked, —in fact, they had to be disregarded,—in building up the system which was founded, as we have seen, upon principles totally unconnected with the qualities of the arm in use. It was successful from the first, it may be said, and that too before the coming of Napoleon. It was successful; but against whom? Against Austrian and German and English armies which had grown grey in the blind worship of the mere letter of Frederic's system, while wholly ignoring its spirit; decrepid armies commanded by men of poor capacity.[1] The revolutionary hordes would have dissolved before a great commander. The picturesque 'cloud of skirmishers,' in truth an

[1] "Le defaut d'un chef unique, la différence des intérêts et l'incapacité des généraux de la coalition, sauvèrent la république." —Chambray, "Des Changemens . . . dans l'Art de la Guerre;" Œuvres, v. 224.

unmanageable mob, was swept to the winds in open ground by the enemy's Cavalry,[1] or collected in masses which were crushed by Artillery. They then betook themselves to broken ground, "le pays exécrable où Dumouriez avait eu l'habilité de forcer l'ennemi à se jeter;"[2] and there they gained their first successes,—"dans les lieux où le terrain rendant les manœuvres impossibles, la valeur et l'habilité individuelles faisaient pencher la balance en notre faveur."[3] In plain English, the early battles of the Revolution, like the early battles of the American War of Secession, were what General Rosecrans called 'bushwacking on a large scale;' and bushwackings they continued to be until the conscripts were broken by discipline into soldiers. Decisive battles can only be fought with soldiers, and "men are not soldiers until they are disciplined."[4] General Thièbaldt dispels once for all the popular and romantic theory that the early successes of the French were gained by devoted bands of

[1] "Battus continuellement en plaine, et ne pouvant espérer d'y résister à la meilleure Cavalerie de l'Europe."—Duhesme, p. 70.

[2] Mémoires du Gén. Baron Thièbaldt; i. 337.

[3] Duhesme, p. 70. See also "Mémoires sur les Campagnes des Armées du Rhin, &c.," Marshal Gouvion St. Cyr; i. 38, 53.

[4] Frederic the Great's "Secret Instructions, &c.," p. 3.

undisciplined conscripts.[1] "Sans les lenteurs systématiques des Autrichiens surtout, nous étions perdus cent fois pour une. Eux seuls nous ont sauvés, en nous donnant le temps de faire des soldats, des officiers, des généraux." [2]

And now Napoleon appeared upon the stage of war, and his splendid triumphs with skirmishers and small columns produced the usual effect: men attributed his victories to the formations themselves, instead of to the use he made of them. In consequence, an epidemic of imitation broke out which Rüstow describes as of unparalleled severity.[3]

In 1812 appeared a new Prussian Ordonnanz, fully adopting the French fire-formation of Skir mishers, followed by a line of Columns. The Battalions consisted of 1000 men each, in 3 ranks, divided into 4 Companies of 2 Sections (Züge) each. The third ranks acted as Skirmishers, and

[1] This legend is merely the counterpart of the legend that a handful of patriotic volunteers drove the British armies out of America,—a fable disposed of by Lamarque. "'Les préventions du Congress contre les troupes de ligne lui faisaient concevoir l'espoir insensé d'organiser chaque année une armée capable de résister à l'ennemi' (Botta, 'Hist. de la Guerre américaine'); mais la bataille de Brooklyn fit voir que la valeur personelle ne peut pas suppléer à l'instruction et à la discipline, et Washington, *le plus grand ennemi des milices*, obtint une armée permanente. C'est avec elle, c'est surtout avec les sécours de la France qu'il assura l'indépendance de sa patrie."—"De l'Esprit militaire en France," Paris, 1826; p. 59-60.

[2] "Mém., &c.;" i. 413. [3] "Gesch. d. Inf.;" ii. 319.

the remainder followed, as a general rule, in Battalion-columns of Sections in rear of the centre Sections, 4 and 5; the Column being 8 ranks deep, with a front of about 83 men. Thus the fire-formation of the Prussians was $\frac{1}{3}$ the strength of the Battalion, while that of the French was only $\frac{1}{6}$. The large Battalions, and the large Companies of 250 men with only 4 officers, were due to the financial embarrassments of the Prussians. Crushed by the cost of almost perpetual war and also, no doubt, by the exactions of Napoleon, Prussia could not adopt the small French Company of 80 or 90 men, owing to the increased number of officers thereby entailed, and the consequent expense. She endeavoured, accordingly, to make good in quality what was wanting in the quantity of her officers.

It is clear that this system, however it be regarded, developed less fire than deployed lines in 3 ranks, even if the third ranks held their fire, as suggested in the English Infantry Regulations of 1801. "When Infantry marches to the attack . . . it is perhaps better to fire the 2 first ranks only standing, reserving the third."[1] The fire of

[1] "Rules and Regulations for the Formations, &c. of H.M.'s Forces." Adjutant-General's Office, 1801, p. 96.

the skirmishers was at most the fire of $\frac{1}{3}$ the battalion. If they retired and formed up in rear of the column, the fire of the battalion was represented by the fire of only 2 sections,—or $\frac{1}{4}$ of the battalion. On the other hand, the fire of a deployed line in 3 ranks, the third rank holding its fire, was that of $\frac{2}{3}$ the battalion.

In the second place, the Battalions and Companies were too large, even if fully officered. Since fire-arms acquired any power on the battlefield, their influence has invariably been to reduce gradually the strength of the various bodies of Infantry. The reason is not far to seek. The area, the extent of front and depth, over which a regimental officer can exert his command may be taken to be a constant quantity, because it depends chiefly upon the human voice and other physical qualities of man which (practically) do not change. But as the precision and rapidity of small-arms increase, the number of men occupying this area decreases as shown in Table A. In fact, Infantry gradually expand as their fire improves. Therefore in the progress of time and improvement the different commands and fractions of Infantry have an unmistakable tendency to decrease in size. So long ago as the 16th century this tendency was

plainly visible.[1] The dense formations of that century dwindled to the brigade of Gustavus Adolphus, about 1000 men. His brigade fell to the 600 men of Frederic's battalion. The natural development of this battalion was the English battalion of the Peninsular war, 450 to 600 men. The French and German battalions of 1000 men were a retrograde step. Marshal Bugeaud, a high authority on such matters, held that a deployed Battalion of 800 men in 2 ranks, was too extended a command for the majority of battalion commanders.[2] General Duhesme, whom Napoleon spoke of as "soldat intrépide et général consommé," goes even further. He says :—"il est impossible de faire manœuvrer avec facilité un bataillon qui a plus de 600 hommes. Je dirai plus, c'est qu'un bataillon très-nombreux ne fera pas mieux et sera peut-être plus tôt mis en déroute qu'un de 4 à 500 hommes."[3] The improvements in fire-arms only accentuate the opinions of these able men.

[1] Rüstow ; ii. 238.

[2] "Aperçus sur quelques détails de la Guerre," Paris, 1846 ; p. 152.

[3] "Essai, &c. ;" p. 267. Years before Duhesme wrote a Hessian officer had said :—"un bataillon de plus de 200 files serait plus de mal que de bien, en ce que peu d'officiers auraient la voix assez forte pour le commander, et surtout en ce qu'il serait trop sujet aux flottemens en marchant."—"Essai sur l'influence de la poudre à canon, &c.," J. von Mauvillon, Leipsig, 1788 ; p. 56.

Thirdly, as a matter of fact, the German Companies were, and are under-officered.[1] This is a serious defect, especially in the Prussian Army which requires a large proportion of officers. "The spirit of the Prussian Army is in its officers," said General von Rüchel; a sentiment quoted with approbation by Prince Kraft of Hohenlohe-Ingelfingen in his "Letters on Infantry."

It is time to enquire why England made a change in her fire-formation at the beginning of this century, although no improvement of any moment had taken place in small-arms; and why, in making the change, she selected the deployed line, 2 deep.

Three influences had been at work in the English army, for longer or shorter periods, all tending to the 2 deep line.

The first of these influences was the inherent badness of the 3 deep line as a fire-formation. The difficulty, in short, was this:—the first rank could not load when kneeling, although it might fire in this position; and the third rank could not fire while the first rank was standing, except (as Capt. Panot says) at the imminent peril of the

[1] See "Twenty-four Hours of Moltke's Strategy," by F. Hönig, trans. by Col. Walford, 1895; pp. 96, 97, 104, 137, 138.

latter.[1] Now when the enemy was close it was out of the question to permit the front rank to kneel down: volley-firing, with the front rank kneeling, was only permitted by the English Regulations when the enemy was "at a considerable distance"[2] (250 to 300 yds.). At the critical moment, therefore, the front rank was obliged to fire standing; the fire of the second rank, squeezed in between the first and third, was not very effective; and the third rank either looked idly on, or distracted the two other ranks by a fire which was always too high.[3] Napoleon summed up the matter in a few words:—"le troisième rang ne sert à rien au feu, il sert encore moins à la baïonnette."[4]

The second influence was the gradual introduction of Light Infantry into our service.

For many years the pressing need of a sufficient

[1] "Cours sur les Armes à feu portatives," Paris, 1851; p. 258. This was no mere fancy of Capt. Panot's. "Si les soldats du troisième rang veulent tirer par les creneaux, ainsi que cela arrive presque toujours, ils tirent trop haut et blessent quelques soldats du premier rang, ordinairement au bras droit, pendant qu'ils bourrent." —Marq. de Chambray, "Œuvres;" v. 317.

[2] "Rules, &c. for the Formation, &c. of H.M.'s Forces," 1792; p. 96.

[3] "Mém. de Marbot;" ii. 483.

[4] Letter to Marmont, Lüben, 13 Oct. 1813. The arguments against the 3rd rank are well stated in the article 'Feu,' "Encyclopédie Méthodique," Paris, 1785.

and permanent force of Light Infantry had made itself felt whenever we took the field. During our American war in the middle of the last century which culminated on the Plains of Abraham, the nature of the country necessitated a free use of Light Infantry; and the Light Infantry required had to be improvised on the spot. "A body of Light Infantry will be formed from the different corps to act as irregulars,"[1] says an Order, dated Halifax, 12th May 1758. "The regiments that have been any time in America are to furnish such men as have been accustomed to the woods and are good marksmen; and those from Europe are to furnish active marchers and men that are expert at firing ball."[2] Owing to these experiences probably, on the breaking out of the American war in 1775 we formed a Light Company in each Battalion; but these Companies were without connection or cohesion, and (as events showed)

[1] We seem to hear the voice of old Brantôme again:—"ceste confuse et nouvelle forme de combat" (of the Spanish skirmishers at Pavia, 1525), . . . "une vraye confusion et désordre . . . contre tout ordre de guerre et ordonnance de bataille."—"Œuvres, &c. du Seigneur de Brantôme," Paris, 1822; i. 225.

[2] "Hist. Journal of the Campaigns in N. America," Capt. J. Knox, London, 1769; i. 159. A 90th L. I. was raised in 1760 and disbanded in 1763. Another 90th L. I. was raised in 1779 and disbanded in 1783. I am unable to say what formation they adopted, or why they were called Light Infantry.

without any knowledge of their special duties. They are shown in our first Drill Book, by Sir David Dundas,[1] formed by Subdivisions, 2 deep, in rear of the flanks of the Battalion in line. They were formed 2 deep, because owing to the slowness of their fire-arm, musket or rifle, our system of skirmishing was founded upon the reasonable principle, that two men should always work together. These two men were never to separate, and one was never to fire until the other "put the ball into his piece."[2] This explains why Major Davey, 60th Rifles, when on the point of embarking for the Peninsula, June 1808, applied for a loading-mallet for 'each two men' under his command.[3] The reason for which Light Companies were formed in the 2 deep line applied, of course, with equal force to all bodies of light troops; and our Rifle and Light Regiments, from the moment they were raised, used the same formation.[4]

Finally, there was a third influence at work,

[1] "Principles of Military Movements," London, 1788.

[2] "Regs. for . . . Riflemen and Light Inf.," 1803; p. 18. This system was of course observed by the French:—"l'Infanterie anglaise," says Chambray, "se couvre par de nombreux tirailleurs qui sont réunis par couples."—"Œuvres;" v. 347.

[3] "Celer et Audax," Gen. G. Rigaud; p. 24.

[4] "Observations on . . . Riflemen," Sergt. J. Wedderburne, 95th (Rifle Regt.), 1804; p. 12.

making for 2 ranks, which was wholly unconnected with the qualities of the arm in use,—the low establishment of our Battalions. As early as 1786, "Commanding Officers of Battalions (were) permitted, till further orders, to perform the exercise and go through their firings and manœuvres, 2 deep," owing to the low establishment; but the men were also to be exercised 3 deep.[1] Again in 1792, "from the low establishment of our Battalions," Commanding Officers "are permitted to form and use" deployed lines, 2 deep; but they are to "frequently practice their movements in 3 ranks."[2] Let us trace the working of these three influences.

The disasters in America naturally rankled in the minds of soldiers, and they ascribed these reverses (with much justice) not only to bad leading, but to the want of Light Infantry and to the 3 deep formation. While soldiers were in this frame of mind came the war in the Low Countries and the French skirmishers, against whom it was absolutely necessary to protect our deployed lines. It was in these campaigns, indeed, while serving

[1] "Gen. Regs. and Orders, &c.," 1786; p. 11.

[2] Quoted in Dupin's "Mil. Force of Great Britain," 1822; ii. 144.

under H.R.H. the Duke of York, that Scharnhorst first learned the importance of Light Infantry.[1] To meet the pressing emergency the Horse Guards raised the 90th L. I. (for the third time) in 1793, and converted a Battalion of the 60th (probably the 1st) into Light Infantry in 1794,[2] armed with an unknown rifle. Another Light Infantry Battalion, the 5th of the 60th, was raised in 1797,[3] and in 1800 (what we now call) the Rifle Brigade was formed. The riflemen were armed with Baker's rifle, which was sighted to 100 yds., with a folding sight for 200 yds.[4] Baker says he could hit a painted man on a 6 ft. target 32 times out of 34 shots at 100 yds., and 22 times out of 24 shots at 200 yds.[5] These statements are corroborated by the performances of Captain Wade and Privates Smeaton and Spurry, who used to hold up targets for one another and hit them at 150 yds.[6] The

[1] "Scharnhorst, u. d. Durchführung d. allgem. Wehrpflicht," W. Weise, 1892; p. 15.

[2] "The First British Rifle Corps," Major Verner, R.B.; p. 22. A single Light Company was formed from the 3 Batts. of the Guards in the Low Countries in 1793,—presumably by order of H.R.H. the Duke of York. Light Companies were introduced almost immediately afterwards, but were reduced in 1801. Sir F. Hamilton's "Hist. of the Grenadier Guards;" ii. 274.

[3] "Celer et Audax," Gen. G. Rigaud.

[4] Sir W. Cope's "Hist. of the Rifle Brigade;" p. 515.

[5] "Remarks on Rifled Guns," 9th ed., 1825.

[6] "Hist. of the Rifle Brigade;" p. 10.

52nd and the 43rd were converted into Light Infantry in 1803; and in this and the two following years the 4th, 43rd, 52nd, 59th, 70th and Rifle Brigade were among the Regiments that were brigaded under Sir John Moore at Shorncliff Camp, where for the first time perhaps in our military history methodical and practical instruction was given to the troops.

Moore's system was comprehensive and complete, extending "from the setting up of a recruit to the movement of a Brigade."[1] Nor was it confined to mere drill. "In Shorncliff," says Sir Charles Napier, "the ridiculous clubs of hair . . . were cut off, and long gaiters and pipeclayed breeches[2] replaced by trowsers and half-boots; there the polishing of gun-barrels was abolished, brown barrels introduced, and the bayonet fastened by a spring instead of the defective zig-zag; there the ranks were reduced from three to two;[3] and the only really sure and always practicable square, by wheeling up of Sections at quarter distance, was

[1] "Life of Gen. Sir C. Napier," by Gen. Sir W. Napier; i. 59.

[2] "I saw the Bailie's lass cleaning his belts and white breeks," says Edie Ochiltree in the "Antiquary," alluding to the threatened invasion of 1803-4.

[3] "Ce furent ces régimens (at Shorncliff) qui se formérent les premiers sur deux rangs."—Chambray, "Œuvres;" v. 361.

devised."[1] Light Infantry movements, of which Moore's varied services (especially in Sicily and St. Lucia) had made him a master, were assiduously practised; and I believe the division of light troops into three distinct bodies, Skirmishers, Supports, and Reserves, may be traced back to the camp at Shorncliff.

It is certain, then, that in addition to countless other beneficial reforms, Sir John Moore introduced the 2 deep line among the troops under his personal command; but here his influence seems to have ended,—for a time, at least. "Les méthodes de Moore," says the Marquis de Chambray, "ne se répandirent que successivement dans l'armée anglaise."[2] They were not fully appreciated even when their merits had been triumphantly demonstrated by the conduct of the Light Division in the field.[3] Moore certainly failed to bring round

[1] "Defects, Civil and Military, of the Indian Government," 1853; p. 308.

[2] "Œuvres;" v. 362.

[3] An eyewitness says that the great loss of the 24th and 79th at Fuentes d'Onoro was due to the fact that these two regiments "were practising Light Infantry movements for the *first* time in their lives."—"Leaves from the Diary of an Officer of the Guards," London, 1854; p. 92. Baron Müffling, when recording his opinion that "for a battle, there is not perhaps in Europe an army equal to the British," is careful to add:—"there is no army in Europe less experienced in the light and detached service than the British."—

the Horse Guards to his views; for the Regulations of 1804 (when the camp at Shorncliff was in full working order) direct that "the established order of formation of Infantry is in 3 ranks, which is not to be departed from, except in Light Infantry Battalions . . . without special permission of the Commanding (or Reviewing) General."[1] This regulation was repeated verbally in the Regulations of 1808. The 3 deep line, therefore, was seemingly to remain the fire-formation of our Infantry of the Line for countless years to come: as matters fell out its course was nearly run.

In August 1808, an English army reached the shores of Portugal under Sir Arthur Wellesley. He had already served against the French in the Low Countries; and when he heard (in India) of their great successes under Napoleon, he exclaimed:—"I know we can beat them, if we fight them in line." He had now an opportunity of testing the value of his opinion, and he took it. He determined to fight not only in deployed line, but in the 2 deep line. He scoffed inwardly,

"Hist. of the Campaign of the British, Dutch, &c. Armies in 1815," 1816; p. 81. The 'Adjutant-system' was, no doubt, the root of the evil.

[1] "Gen. Orders and Observations on the Movts. of Infantry," 1804.

no doubt, at the warning against this formation uttered by the Horse Guards in 1792 :—"no general could manage a considerable army, if formed and extended in this manner."[1] He ignored the stock objection, that such a line was incapable of resisting Cavalry. His 2 deep line was not intended, and was never deliberately used, to receive charges of Cavalry. "On prétend que deux rangs ne présentent pas assez de résistence contre la Cavalerie," says Marbot; "mais l'Infanterie anglaise, doublant ses rangs dans un clin d'œil, se trouve sur quatre hommes de profondeur pour recevoir la charge, et *jamais* nos escadrons n'ont pu la surprendre sur deux rangs, disposition qu'elle réprend lestement dès qu'il faut tirer."[2]

Accordingly, relying confidently on "la valeur innée à l'Anglais,"[3] Sir Arthur Wellesley published a General Order before the troops landed, dated Lavos, 3rd August 1808, which begins :—"the order of battle is to be 2 deep."[4] By these

[1] Quoted in Dupin's "Mil. Force of Great Britain;" ii. 145.

[2] "Mémoires, &c.;" ii. 483.

[3] Mauvillon's "Essai sur l'influence de la poudre, &c.," Leipsig, 1788; p. 345.

[4] Wellington marched in Portugal by "sections of threes," because a front of 3 men "is as large as the greater proportion of the roads in Portugal admit;" G. O., Lousaõ, 16th March 1811. Each Company (in 2 deep formation) was told off (for the march)

simple words he gave England the deadliest fire-formation in Europe. In 1810 a Horse Guards General Order was published extending the 2 deep line to the whole army.[1]

To give coherence to the isolated and unconnected Light Companies of his army, he directed those of each Brigade to be formed in one body under a Field Officer,—an order which he repeated in Belgium seven years afterwards.[2]

From the outset of the campaign the superiority of our fire-formation was undeniable. "Il est certain," says Marshal Bugeaud, "que le feu sur deux rangs se fait avec plus d'ordre, de facilité, et partant il doit être mieux ajusté."[3] Another

by threes, and the column of march was formed by the wheel of sections to the right or left. He again ordered the march by sections of threes in the South of France, "except when forming to attack an enemy;" G. O., Veilla, 18th March 1814. In place of this simple and practical order of march, the Regulations of 1824 introduced a formation of threes which was intricate and unnecessary. The Duke had nothing to do with these Regulations. "In all the changes made since the war in the regulations of the Army," he said to Mr. Croker in 1826, "I have never been in the most trifling or distant degree consulted on any point. . . . There was published a new book of manœuvres and movements" (the Regulations of 1824 above referred to), ". . . and you will hardly credit what I nevertheless assure you is the fact, that I never heard any more about it than you did."—"Correspondence, &c., of J. W. Croker," ed. by Jennings; i. 342–3.

[1] Marquis de Chambray, "Œuvres;" v. 346.

[2] G. O., Brussels, 9th May 1815.

[3] "Aperçus sur quelques détails de la Guerre," p. 152.

eyewitness says:—"la cause principal de nos revers (in Spain) . . . fut l'immense superiorité de la justesse du tir de l'Infanterie anglaise, superiorité qui provient du très fréquent exercise à la cible, et beaucoup aussi de sa formation sur deux rangs."[1] The French columns in the Peninsula, like the Russian columns in the Crimea, forty years afterwards, withered under the fire of the British line. Nor were the French soldiers swept down by our fire mere conscripts. As a French officer generously admits, they were the best soldiers France possessed,—"sans contredit la meilleure (Infanterie) qui restât à Napoléon."[2] "I never on any occasion knew them behave otherwise than well," said the Duke of Wellington. "Their officers too were as good as possible."[3] The result is no matter for astonishment. The abnormal fire-formation which the French had been compelled to adopt, was predestined to failure

[1] "Mém. de Marbot;" ii. 483. Chambray adds two other causes of the inferiority of the French fire:—"Les Anglais, qui se servent de poudre fine, peuvent tirer plus de cent coups avant que de laver le canon" (barrel), "quoiqu'ils emploient des balles de 16 à la livre, tandisqu'en France elles ne sont que de 20 à la livre." The French barrel had to be washed out after about 50 shots. "Œuvres;" v. 293–4.

[2] Chambray, "Œuvres, &c.;" v. 342.

[3] "Conversations with the Duke of Wellington," Earl Stanhope; p. 94.

when brought face to face with the normal development of the English. All that courage could do the French did to avert their fate; but bravery is unavailing against a hail of bullets.[1] I by no means wish to suggest here that success in battle depends solely upon mere fire; I only maintain that Infantry fire is the deadliest force a general wields, and that if his fire-formation is defective the magnitude of the force is proportionally diminished.

A monk probably discovered the projectile force of gunpowder;[2] a monk probably invented cannon; a Jesuit invented the elevating screw for cannon in 1650.[3] The Reformed Church did not contribute its quota to the art of destruction until 1807, when Rev. Alexander Forsyth, a Scotch minister, invented percussion powder for the priming of muskets. This priming was confined in a copper cap in 1815 by Mr. Egg, I believe; and the consequence was the percussion musket, which

[1] Herr Romocki says of the Turkish Infantry fire at Plevna:—"die Geschwindigkeit des Feuers aber und besonders die langen Strecken, welche die . . . Geschosse bestrichen bevor sie auf dem ebenen Schussfelde zur Erde kamen, hatten hingereicht, alle Todesverachtung der Angreifer nutzlos zu machen."—"Geschichte der Explosivstoffe," Berlin, 1896; ii. 35.

[2] See Paper III.

[3] Decker, "Gesch. d. Geschütz.;" p. 54.

came into use a few years afterwards. The following Table C. shows the comparative shooting of this musket and the Minié rifle.[1] This practice was carried out at Hythe by a squad of 20 men who fired 10 rounds each (5 in file firing and 5 in volleys) with each weapon at each range, at a target 20′ × 6′.

TABLE C.

Percentage of Hits, Percussion Musket of 1842.	Range.	Percentage of Hits, Minié Rifle.
	Yds.	
74·5	100	94·5
42.5	260	80.0
16.0	300	55.0
4·5	400	52.5

As this Table sufficiently shows, precision of fire was little, if at all improved by the introduction of the percussion musket. Its rapidity, however, was greater than that of Brown Bess, for no priming was required and the missfires fell in the ratio of 26:1. Mr. H. Latham explains the reason: "The touch-hole of the flint lock was liable to be closed by the smallest accumulation of dirt or fouling, which would cause a missfire, where

[1] "The Gun, &c.," by Greener; p. 609.

the force of the percussion powder would carry a similar obstruction before it."[1] But this was not pure gain: it was counteracted to some extent by a difficulty which arose from the small size of the caps. In bad weather and when the men's hands were cold, there was some delay in getting the caps out of their cartouches, and a number of them fell to the ground. So well known was this latter disadvantage that for a field-day at which 10 rounds were to be fired, 10 blank cartridges and 15 (not 10) caps used to be served out. Making due allowance for this disadvantage, however, the percussion musket was much superior to Brown Bess in rapidity, and its fire was not liable to be interrupted by wind or rain.

In 1761 Robins said:—"I shall close this paper with predicting that whatever State . . . shall introduce into their armies the general use (of rifled-barrelled pieces), with a dexterity in the management of them, will . . . acquire a superiority which will almost equal anything that has been done at any time by the particular excellence of any one kind of arms."[2] Close on a century afterwards this prediction was verified. Rifled

[1] "On Early Firearms," *Journal R.U.S.I.*; ix. 97.
[2] Robins' "Mathematical Tracts;" i. 341.

small-arms were in general use in the fifties; and the following Table D. shows that, so far from overstating, he understated the superiority of their precision to anything that had gone before.[1]

TABLE D.—*Mean Error, or Figure of Merit;* 1858–9.

Rifle.	Range in Yards.			
	75	372	520	744
	Ft.	Ft.	Ft.	Ft.
Dutch . .	.54	2.2	2.7	4.6
Enfield . .	.31	1.5	2.4	3.8
Austrian . .	.43	2.2	...	...
Bavarian . .	.22	1.0	1.7	4.3[2]
Whitworth .	.22	0.92	1.4	3.1

But the increase in precision was accompanied by no corresponding increase in rapidity of fire. In a trial for rapidity made at Hythe in 1858, Sergt. Hines, an expert, only succeeded in firing 35 rounds in 15 mins. with the Enfield rifle.[3] It is certain, therefore, that the average rapidity of the rank and file was under 2 shots a min.

[1] Thierbach; p. 232.

[2] In the original this figure is .33 ms., which I take to be a printer's error for 1.33.

[3] Deane's "Manual of Firearms," 1858; p. 184.

I have described the fire-formation of the French Revolution as an anachronism, because small-arms at that time were too feeble and too slow to justify any very extensive employment of skirmishers. In August 1870, however, this term could no longer be applied to it. Fire-arms had, so to speak, overtaken the open order, and single rank in open order had now become the legitimate fire-formation of Infantry armed with breech-loaders, not only because it gave sufficient development to their fire, but because it is the least vulnerable formation.[1]

So rapid, indeed, was the progress of small-arms, in both precision and rapidity, that one link in the chain of development was over-stepped, single rank in close order (or shoulder to shoulder), and our fire-formation passed at one stride from Wellington's line to skirmishing order (Table A.). This sequence of events, although rapid, was logical. Brown Bess could put 93 per cent. of its bullets into a square of $1\frac{1}{7}$ ft. inside at 60 yds.; at 500 yds. the Snider and Martini-Henry could put 100 per cent. of their bullets into rectangles of $3.5' \times 4'$ and $3' \times 2.5'$

[1] "Observations . . . sur le combat du Bataillon," Commandt. Cousin, Paris, 1896; p. 3.

respectively. "On the common musket at 200 yds. there is no dependence," says the scornful Corporal of Riflemen;[1] the figure of merit of the Lee-Metford at 500 yds. is about 6 inches. At 650 yds. the bullets of Brown Bess, Robins tells us, flew no one knew whither; the figures of merit of the Martini-Henry and Lee-Metford lie between 2 and 3 ft. at 1000 yds. The following Table, E., shows some of the qualities of the old pattern Mauser and the Martini-Henry.

TABLE E.

Martini-Henry.				Mauser.		
Difference.	Velocity.	Height of Trajectory.	Distance.	Height of Trajectory.	Velocity.	Difference.
	F.s.	Ft.	Yds.	Ft.	F.s.	
	1353	0	0	0	1526	
155	1198	4.5	100	3.9	1312	214
123	1075	7.5	200	6.7	1143	169
81	994	8.1	300	7.5	1023	120
57	937	5.8	400	5.4	950	73
48	889	0	500	0	892	58

The trajectories of the Martini-Henry and Lee-Metford at 500 yards are given in the next Table, F.

[1] Corpl. Beaufoy's "Scloppetaria," 1806; p. 17.

TABLE F.

Range in Yards.	0	100	200	300	400	500
	Height in Feet above the Line of Sight.					
Martini-Henry .	0	4.5	7.5	8.1	5.8	0
Lee-Metford . .	0	2.3	4.7	3.9	2.8	0

At the present moment, there is very little to choose between the rifles of the Great Powers. All of them have muzzle-velocities of over 2000 f.s., with corresponding penetrations and not very dissimilar trajectories.

Corporal Beaufoy's Baker rifle took 1½ to 2 mins. to load: in a trial for rapidity (only) made some years ago in this country, the following results were obtained:[1]—

Martini-Henry . . .	40	shots	per minute.
Mauser	28	,,	,,
Chassepot	19	,,	,,
Snider	18	,,	,,
Prussian needle-gun . .	9	,,	,,

With magazine rifles, men can fire as quickly as they can aim;—in fact, the difficulty is to prevent them from firing quicker.

[1] These figures, together with Tables E. and F., are taken from Greener's "Gun and its Development."

From the Thirty Years' War to the general introduction of rifles, the progress of smooth-bores was confined almost entirely to successive increases in the rapidity of fire. When rifles were introduced at the end of the last century, range and precision made a great step forward, but rapidity made as great a step backwards. Even when rifles had been much improved, the rapidity of the muzzle-loaders was no better than that of Brown Bess. But with the breech-loader rapidity and precision made a sudden bound forward together, and the transition from the 2 deep fire-formation to that of the open single rank was the natural and legitimate result.

The comedy of imitation, performed after the victories of Frederic and the triumphs of Napoleon, was revived after the war of 1870 with much spirit and success. The German Company was adopted before long by most continental nations by an Act of Faith,—*in hoc signo vinces.* We in England escaped this *bêtise*, but we introduced a number of other changes that could well have been spared. What was gained, for example, by abolishing the ancient titles of 'Ensign' and 'Cornet,' which are found as early as 1579 in

Digges' "Stradiot?"[1] The secret of the German successes in 1870 is not to be found in cumbrous companies or long-spun titles. While English and French soldiers were throttling one another over the plunder in the Summer Palace at Pekin in 1860, no hands were laid upon a throne that stood in the centre of the Reception Chamber: it was brass, they said, and it was left intact. But—as was discovered when too late—it was not brass; it was massive gold. And so in the case of the German victories in 1870, men seize on gauds and baubles as the instruments of success, while the pre-eminent and all-powerful cause of victory stares them in the face, unnoticed or unheeded—the genius of Moltke. The influence of a general of the first rank upon the fate of a campaign seems altogether overlooked, or under-estimated, in the present day. In 1813, shortly after the battle of Vittoria, Lord Welling-

[1] As long ago as 1590, Sir John Smythe complained that English officers "have so effected the Wallons', Flemings', and base Allemanes' discipline that . . . they will not vouchsafe to use our ancient termes belonging to matters of warre, but do call a *camp* by the Dutch name *lager*, &c., &c. . . . As though our English nation, which hath been so famous in all actions manie hundred years, were now but newlie crept into the world, or as though our language were so barren that it were not able of itself to afford convenient words."—"Certain Discourses . . . concerning divers Weapons;" p. 2.

ton said to his Judge-Advocate-General, when discussing the rumour that Napoleon was coming to Spain, "if he comes here himself, I shall, as I have always done, reckon his presence equal to a reinforcement of 40,000 men."[1] This estimate may give us some notion of the enormous influence of a great general in war; and this advantage the Germans possessed in 1870.

With the open order fire-formation we have apparently reached the ultimate phase of development with the present fire-arms and explosives. But how long will *they* endure? Muzzle-loaders and gunpowder have passed away in our own time, and to-morrow science may bring us new explosives and new arms. Whatever be their nature, the great principle will still hold true, that the best fire-formation is that which gives the fullest scope to the qualities of the arm.

Has the British Infantry lost or gained by the introduction of rifled fire-arms?

By the adoption of the open order fire-formation, necessitated by the increased rapidity and precision of fire-arms, we have undeniably for-

[1] "Private Diary," by Sir George Larpent; i. 246. The Duke reiterated this opinion in 1815, when in conversation with the Allied generals in Paris. "Correspondence, &c., of J. W. Croker," ed. by Jennings; iii. 277.

feited the decided advantage we possessed from the Peninsular to the Crimean war in our 2 deep closed line. It was superior to all continental formations; and it was unique, for no one copied it. Our present formation is common to all Europe.

The comparative disuse of the bayonet, owing to the increased range of fire-arms, is another and a not less serious loss. Sir W. Napier's assertion, that "our only real superiority (lay) in our resolute courage to close with the bayonet,"[1] is undoubtedly too strong; but when every allowance is made for exaggeration, there unfortunately remains but too much truth behind. The less use made of the bayonet, the worse for the British Infantry; for they never shrunk from using it, and using it effectively.

These two losses are irreparable, because we have no control over the causes that led to them; but we can at least *minimise* the loss to which I am about to refer. The numerical inferiority under which we have always laboured in our great wars, has been accentuated by the progress of fire-arms. "The new weapon (is) all in favour of superior numbers," said Sir W. Napier (in the

[1] "Life of Sir W. Napier;" ii. 378.

passage just quoted). The conclusion is that we must strain every nerve to avoid unnecessary loss of men in the field.[1] Now the loss arising from what is conveniently called 'friction' is (at least) 3 or 4 times as great as the casualties upon the field of battle. If, therefore, we can by any means reduce the loss from friction, we shall thereby reap considerable advantage. From what does the loss by friction chiefly arise? From fatigue, says Marshal Gouvion St. Cyr, and from the hardships and privations incurred in campaigning.[2] It is difficult to see how a soldier can be taught to diminish the hardships of the bivouac, except by experience in the field; but we can certainly lessen the loss arising from the fatigue of the march by careful and constant training. Let us take the evidence of a rifleman on this matter. "Marching is an art to be acquired only by habit, and one in which the strength or agility of the animal, man, has but little to do. I have seen Irishmen (and all sorts of countrymen) in their own country, taken from the plough-tail—huge, athletic, active fellows, who

[1] "Lord Wellington *economised* us. . . . In the field he was ever most chary of his men."—"Leaves from the Diary of an Officer of the Guards;" p. 96.

[2] "Méms. sur les campagnes des armées du Rhin, &c.;" iv. 46.

would think nothing of doing forty or fifty miles in the course of the day as countrymen—see these men placed in the rank as recruits with knapsacks on their backs and a musket over their shoulder, and in the first march they are dead beat before they get 10 miles."[1] These are the words of no theorist, but of a practical and brilliant soldier, Sir John Kincaid, who served for several years in the Peninsula as Adjutant of the 1st Battn. Rifle Brigade, and afterwards in the Waterloo campaign. It is of special importance to train our Infantry in marching, because, as the Duke of Wellington guardedly said, marching "is not . . . our men's *forte*." His Judge-Advocate-General, who was an eyewitness of the performances of the French and English armies in the Peninsula for some years, is more outspoken:—"in marching our men have no chance at all with the French. The latter beat them hollow."[2] This defect might be remedied by constant practice; but instead of boldly combatting the evil, we fostered it complacently until quite recently, as the Duke explained to Lord Stanhope:—"we are in the habit of conveying (our Infantry) by steamboat or canal-boat, and

[1] "Random Shots of a Rifleman," London, 1835; p. 86.
[2] Sir George Larpent's "Private Diary;" i. 211.

never letting them walk. First, it saves the public money, and then it saves the commanding officers trouble."[1]

A man can only march a certain distance; in other words, he possesses only a certain limited amount of energy available for locomotion. Therefore every unnecessary exertion, however small, is a wasteful expenditure of energy. Consequently every regulation affecting the natural swing of a man's arms, the natural position of his head, or the natural length of his pace on the march, reduces his capital of energy.[2] I am inclined to think that the regulation pace of 30 ins. is not the natural (average) pace of our Infantry-soldiers: it is too short. If separate experiments were made with the 20 tallest and 20 shortest men in 20 Battalions, the average pace would probably be found to be 31 or 32 ins.; and if such be really the case, it is pure waste of energy to compel them to step 30 ins. If this surmise be correct, and if the natural (average) length of pace were adopted by regulation, the fatigue of marching could be sensibly lessened by diminishing the

[1] "Conversations with the Duke of Wellington;" p. 25.

[2] One of the leading principles on which Sir John Moore based his Shorncliff reforms was that, as far as practicable, every action of a soldier should be done in the most natural way.

regulation number of steps per minute, without decreasing the present rate of marching. A distance of 10 miles is covered in 2 hrs. 56 mins. by marching (as at present)—

120 paces of 30 inches per minute,
Or—116 „ 31 „ „
Or—112 „ 32 „ „

But the best of all plans, for the actual march, would be to allow every man to carry his arms and to step as he pleases, always provided that the present rate of marching is not decreased and that the ranks are not broken.

The practice of marching is all the more necessary since we have adopted Short Service for our Infantry. In the mere matter of fighting young soldiers are as good as old ones. "I have found," said the Duke of Wellington, "that raw troops, however inferior to the old ones in manœuvring, are far superior to them in downright hard fighting. . . . At Waterloo, the young Ensigns and Lieutenants who had never seen a battle, rushed to death as if they had been playing cricket."[1] But young soldiers are undoubtedly inferior to old ones in campaigning qualities, and suffer far

[1] "Table-Talk of Samuel Rogers;" p. 292.

more from 'friction.' "I prefer having one officer or soldier who has served one or two campaigns," said the Duke on another occasion, "to having two or three who have not. . . . By filling the hospitals, (young soldiers) are a burden to us."[1] Sir John Kincaid explains the reason why. "The most difficult, and at the same time the most important duty to teach a young soldier on first coming into active service, is how to take care of himself. . . . The young soldier, when he first arrives in camp or bivouac, will (unless forced to do otherwise) always give in to the languor and fatigue which oppresses him, and fall asleep. He awakens most probably after dark, cold and comfortless. He would gladly eat of the undressed meat in his havresack, but he has no fire on which to cook it. He would gladly shelter himself in one of the numerous huts which have arisen around him since he fell asleep; but as he lent no hand in the building, he is thrust out. He attempts at the eleventh hour to do as others have done, but the time has gone by; for all the materials that were originally within reach, have already been appropriated by his more

[1] Lord de Grey's "Characteristics of the Duke of Wellington;" p. 91.

active neighbours, and there is nothing left for him but to pass the remainder of the night as best he can, in hunger, in cold, and in discomfort, and he marches before daylight in the morning without having enjoyed either rest or refreshment. Such is often the fate of young Regiments for a longer period than would be believed, filling the hospitals and leading to all manner of evil.

"On the other hand, see the old soldiers come on the ground. Let their feelings of fatigue be great or small, they are no sooner suffered to leave the ranks than every man rushes to secure whatever the neighbourhood affords as likely to contribute towards his comfort for the night. Swords, hatchets, and billhooks are to be seen hewing and hacking at every tree and bush within reach; huts are quickly reared, fires are quickly blazing . . . the camp-kettle is boiling, or the pound of beef frying. The meal finished, they arrange their accoutrements in readiness for any emergency . . . dispose themselves for rest, and be their allowance of sleep long or short, they enjoy it."[1] We can now understand why a French officer looked upon our old soldiers in the Peninsula as constituting one of the causes of our

[1] "Random Shots from a Rifleman;" pp. 87–91.

superiority :—" (l'Infanterie anglaise) contenait beaucoup plus d'anciens soldats que l'Infanterie d'autres Puissances."[1] In this matter we are now no better and no worse than our neighbours.[2]

As some compensation for the losses I have mentioned, we still possess a superiority over our neighbours in our small, manageable, and well-officered Companies. The war-strength of our Company is too great, it is true, 120 men ; but it can readily be diminished, and even as it stands our Company is much more mobile and practical than one of 250 men. Well may General Philebert ask : —"quelle action peut avoir un chef de bataillon sur 1000 hommes . . . placés sur un ou deux rangs, un capitaine sur ses 250 hommes mélangés et pêle-mêle avec ceux d'autres compagnies ?"[3] A Colonel cannot efficiently command more than 600 men ; a Captain and two Subalterns cannot successfully lead more than 80 men under present conditions. At its origin, in the days of Brown Bess, the German Company was no

[1] "L'Infanterie," Marquis de Chambray, Paris, 1824 ; p. 36.

[2] "Par une singulière coïncidence historique, c'est au moment où l'efficacité de l'armement devient si intense que disparaît le soldat de profession."—"Du Rôle . . . de l'Infanterie, &c.," Commandt. Welter, Paris, 1894 ; p. 28.

[3] Ibid., p. 25.

more than a financial necessity: in these days of magazine rifles it is a worthless relic of the past. Our small companies are in harmony with the tactics of the day: let us hold fast by them.

But the internal organisation of our Company admits of improvement. Our present Company is essentially the two-rank company of Vimiera and Vittoria; and while we are forced to fight in one rank, we still manœuvre in two.[1] Our system is a double one, and consequently violates the principle of simplicity:—the simpler the machine, the better it works. Could this double system be shown to be either necessary or convenient, there would be an end of the matter; but it seems to be neither the one nor the other. An example will explain my meaning best. Suppose that a single Company of 40 files is formed up on the edge of the fire-zone, and that the Captain resolves to throw out No. 1 Section, *i.e.* 20 men, as skirmishers. No. 1 Section advances and forms single rank, *front and rear-rank man alternately*, at some given interval, &c., &c.

[1] "L'Infanterie combat sur un rang . . . elle manœuvre sur deux rangs . . . (elle) doit manœuvrer comme elle combat et combattre comme elle manœuvre."—"Considérations sur la Tactique de l'Infanterie," Colonel Mignot, Paris, 1895; pp. 6, 7.

Is this the simplest and quickest (and therefore the best) mode of throwing out skirmishers? Surely not. The interpolation of the rear-rank men among the front-rank men is far removed from the simplicity absolutely necessary in modern war; and as General Philebert well says:—"il faut absolument décider à la simplification radicale."[1] To avoid this unnecessary complication, we have only to tell off the present front rank of the Company as the Right-Half-Company, and the rear-rank as the Left-Half-Company; each Half-Company being divided into 2 Sections, and each Section into 2 Platoons.[2] By such a procedure, it will be said, the double-rank Company in Line becomes a single-rank Company in Close Column of Half-Companies. That is so, and why not? We are in precisely the same position with regard to single rank to-day that we were in regard to double rank a century ago. Are we going to rehearse the same drama of vacillation about the single-rank formation now, that we played about the double-rank then? The changes involved in

[1] "Apropos des Manœuvres de 1889;" p. 26.

[2] I propose the reintroduction of this old word because it is shorter than 'Subsection,' and because its sound is so totally different that it can never be mistaken for 'Section' or 'Half-Company.' Besides, it recalls the Siege of Namur and Blenheim.

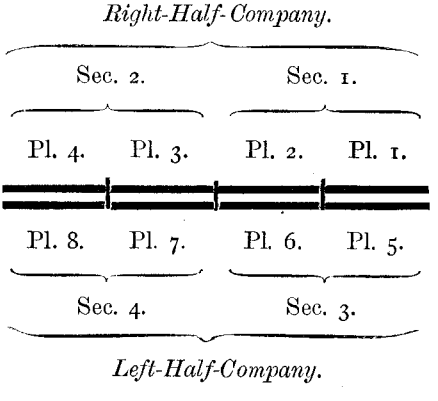
passing from 2 ranks to 1 rank are no greater than those required to pass from 3 ranks to 2 ranks; and if Sir Arthur Wellesley could successfully change *his* formation in face of an active and spirited enemy, we can surely make shift to change *ours* in time of peace.

Close Column of Half-Companies, *i.e.* the present double-rank Company in Line, being taken as the normal formation of the Company, the proposed organisation would make little change in the present Battalion drill, and no change whatever in the length of the column of march. Column of Sections, or Platoons, can easily be formed *direct* from Column of Half-Companies, without an intermediate formation of (single-rank) Line,—a formation the Company would *never* assume except by special order. Lines and Columns in single-rank formation would take ground to a flank by 'Twos,' *i.e.* the formation of either of the present ranks (considered separately) in the present Column of Fours. 'Twos' have all the advantages of 'Fours,' with only half the extent of front.[1] To throw out 20 skirmishers from the single-rank Company (of

[1] On a Company in Close Col. of Half-Companies receiving the command, "Form Twos—Right (or Left)," the rear Half-Company would step back as at present, and as both ranks would form 'Twos,' the whole would be in fours, exactly as now.

80 men in Close Column of Half-Companies), our supposed Captain has merely to send forward either of the new (single-rank) Sections of the new Right-Half-Company, both of which Sections contain 20 men. The other Section of the *same* Half-Company would follow in support. Here we have absolute simplicity: the men who are to skirmish are shoulder to shoulder, and have merely to advance and extend.

PROPOSED COMPANY IN CLOSE COLUMN OF HALF-COMPANIES.



This change in the organisation of the Company would enable us to take a step which common-sense points out as of paramount importance in long-range firing, namely, to form the Right-Half-Company (the present front rank), not of the

tallest men, but of the best shots in the Company. The reason is palpable. In 99 cases out of 100, either (or both) of the Sections of the (new) Right-Half-Company would go into action first; they would consequently commence firing at the longest ranges; and they ought therefore to be composed of the best shots available.[1] The range (as a rule) would be reduced before the rear Half-Company, or either of its Sections, would reach the firing line.[2]

By this or some such reorganisation we should pass from a complex dual to a simple single system,—from the two-rank formation of the past to the one-rank formation of the present; and our Company would gain a marked advantage over the Companies of the Continent.

Returning to our main argument, there remains to be mentioned an unexpected benefit conferred upon our Infantry by the open order formation. It has given the death-blow to a state of things which it is not easy to describe,—a kind of regimental Nirvana, the official absorp-

[1] Major Lorenzo says that the fire of the good shots of the Italian Army, taken as a body, is three times as effective as that of the bad shots; "Tiro della Fanteria;" p. 28.

[2] In the proposed normal formation of the Company, the Right-Half-Company is *always* in front. For mere Battalion drill, or Ceremonial, it matters not which is in front.

tion of the officers of the Battalion in their Colonel,—a system which apparently still lingers on in a few belated Battalions.[1] This system, always bad, is more mischievous than ever in the present state of tactics. Since the introduction of open-order fighting, the Captain has become a very important officer in whom every confidence must be placed; and common-sense dictates that in peace we should concede to him that freedom of action which we *cannot* withhold from him in war.[2] The Colonel is still the Alpha, but he is no longer the Omega of the Battalion: his *rôle* is altered, and he must accept the situation. The basis of the system I speak of is the preposterous maxim, "if you want a thing well done, you must do it yourself;" which supposes a perfection in

[1] "In his report on the Autumn Manœuvres in the neighbourhood of the Curragh, Major-General Combe complains that in Infantry Drill . . . the executive is entirely in the hands of the Commanding Officer, Captains of Companies having practically no responsibility. 'So habituated are Comg. Officers to retain the entire control of the battalion in their own hands at drill' (says General Combe), 'that at manœuvres they not infrequently are seen actually in the firing-line, taking command of Companies, and even giving orders and directions to Section Commanders.'"—*The World*, 11th November 1896.

[2] "Lieut.-Colonels must hand over the actual leadership of the fighting-men to the officer who has taught them the art of war, and is the only one who can properly guide them in the hour of trial, viz., the captain of the company."—Gen. Sir R. Harrison, *United Service Maga.*, November 1896; p. 124.

'yourself' that no sane man can lay claim to.[1] The result of the system is that the Company officers, Subalterns as well as Captains, may be suddenly called upon, under a storm of bullets perhaps, to assume a grave responsibility which has never been laid upon them in time of peace. Such a system invites disaster.[2]

The conclusion of the whole matter is that no time, no labour, no money is wasted if spent upon the fire of our Infantry:—"l'arme à feu est tout; le reste est peu de chose."[3] If, as our adversaries have assured us, our fire was superlative at the period of Fontenoy and in the Peninsular war, there is no reason why, with careful training and persistent practice, it should be second to that of any nation now. And let us not forget that however effective our Field Artillery, however excellent

[1] "It should be borne in mind, on the one hand, that no man is a competent judge on *all* subjects; and, on the other, that every man is a competent judge on *some*."—"On the Influence of Authority in matters of Opinion," Sir G. C. Lewis; p. 165.

[2] Subordinates "should enjoy a certain measure of independence which, besides the responsibility that would attach to them, would give them a pleasure and an ambition in their calling. . . . It is only by inculcating self-dependence and entrusting them with responsibility in time of peace that their characters can be moulded for war and the more gifted natures discovered."—"On Responsibility in War," by H.I.H. the Archduke Albrecht of Austria, translated by Col. Ouvry, London, 1869; pp. 31, 33.

[3] Napoleon.

our Cavalry, we stand or fall with our Infantry. As Captain Jacquinot de Presle truly told the Cavalry cadets at the Saumur College, "l'Infanterie est la première des armes. C'est elle qui fait la force des armées; c'est par elle que les nations conquérantes ont vaincu; c'est par la ruine de leur Infanterie que ces mêmes nations ont été subjuguées." [1]

[1] "Cours d'Art et d'Hist. Militaires," Saumur, 1829; p. 100.

II

ON MARKING AT RIFLE-MATCHES

THE following remarks are not intended to apply in any way to the Hythe system of musketry, which, if an opinion may be hazarded from the slight acquaintance that can be gained of it from the "Musketry Regulations," is practical and well suited for its object. They refer exclusively to the small rifle-matches that are continually taking place all over the country for prizes. A system designed for the instruction and classification of many thousands of men, must be to some extent a rough and ready one; but in the case of a handful of marksmen, competing at their leisure, it is folly to employ a system of scoring under which the best shot may fail to win the first prize.

To devise a perfect system of marking for match-shooting is quite impracticable, owing to the necessarily limited number of rounds competitors fire. Nevertheless, although 'luck' and constant causes of error cannot be entirely elimi-

nated, it is not impossible to find a better system than the present one.

In the present system a bullseye counts 5, an outer 2. Therefore A, who puts a bullet into a purely arbitrary circle called the bullseye, gets 3 marks more than B who makes an outer; while B gets only 2 marks more than C who misses the target altogether. This is unjustifiable; and if a bullseye is counted as 4 and an outer as 1, matters are even worse. Again, if D just hits a corner of the target, and E just hits either side of the target half way up; both score 2 for an outer, although D's hit is half the diagonal of the target, and E's hit is only half the breadth of the target, from the centre (with a 2nd class target, about 3.9 ft. and 2.9 ft. respectively from the centre). This is equally unjustifiable, and forms a strong argument in favour of Sir John Herschell's proposal for circular targets;[1] or, if the target happen to be square or rectangular, for treating outers as misses, and permitting only bullseyes, inners and magpies to count.

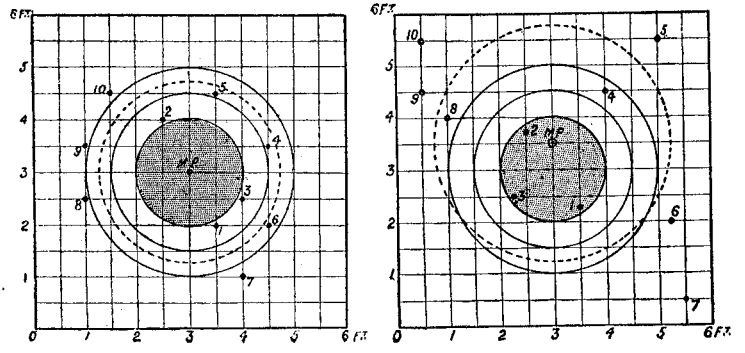
With the present system, is the prize always carried off by the best shot? The best shot, no

[1] "On Target Practice," in "Familiar Lectures on Scientific Subjects," London, 1866.

doubt, takes the prize in the majority of cases, but he certainly does not do so in *all* cases. Consider the following scores.[1]

FIG. I.

A's SCORE. B's SCORE.



The results are:—

A.		B.	
3 Inners . . .	12	3 Bullseyes . . .	15
3 Magpies . . .	9	1 Magpie . . .	3
4 Outers . . .	8	6 Outers . . .	12
Total . .	29	Total . .	30

Therefore B wins by 1 point. I submit that A's shooting is the best. Let us calculate the

[1] The order of shots is quite immaterial.

mean errors, or figures of merit, of the two scores. The following is the work :—

A's Score.				B's Score.		
Horizontal Measurts.	Vertical Measurts.	Absolute Deviation from Mean Point.	No. of Shot.	Absolute Deviation from Mean Point.	Vertical Measurts.	Horizontal Measurts.
Ft.	Ft.	Ft.		Ft.	Ft.	Ft.
3.5	2.0	1.12	1	1.34	2.25	3.50
2.5	4.0	1.12	2	0.56	3.75	2.50
4.0	2.5	1.12	3	1.25	2.50	2.25
4.5	3.5	1.58	4	1.41	4.50	4.0
3.5	4.5	1.58	5	2.83	5.50	5.0
4.5	2.0	1.80	6	2.70	2.0	5.25
4.0	1.0	2.23	7	3.90	0.50	5.50
1.0	2.5	2.06	8	2.06	4.0	1.0
1.0	3.5	2.06	9	2.70	4.50	0.50
1.5	4.5	2.12	10	3.20	5.50	0.50
30.0	30.0	16.79		21.95	35.0	30.0
3.0	3.0	1.68		2.19	3.5	3.0

By this test A clearly comes out best, the mean errors being :—

A	B
1.68 ft.	2.19 ft.

Again, the mean point of A's shots is the centre of the target, while B's mean point is 6 ins. from it.

If we calculate the horizontal and vertical Probable Errors of both, A again comes out first, the figures being :—

Probable Error of 1 *Shot.*

A	B
hor. .94 ft.	hor. 1.3 ft.
vert. .79 ,,	vert. 1.09 ,,

Finally, if we calculate the radius of Sir John Herschell's 50 per cent. circle, *i.e.* the circle within which it is even betting one half the bullets would fall were a large number of rounds fired, A is again first, the figures being :—

Radius of 50 *per cent. Circle.*

A	B
1.72 ft.	2.32 ft.

A is the best shot, because his circle is the smallest. The broken circles in Fig. 1, whose centres are the respective mean points (of impact), are the circles in question.

Judged by all ordinary tests, then, A's shooting is the best; yet B gains the prize by the present system of marking, whether the bullseye be taken as 5 or as 4 points. The conclusion is that the present system of marking is defective. The scores just examined, it may be said, are specially constructed scores and do not represent

ordinary shooting. It may be answered that no method of scoring can be called a sound one which does not *always* ensure the prize for the shooting which, by all ordinary tests, is the best. In the case in hand, B has won the prize by what may be called the tyranny of a purely arbitrary bullseye.

How can the defects of the present system be remedied? When a marksman fires a shot his object is to hit the very centre of the target. The nearer his bullet goes to the centre, the better his shot; the further from the centre, the worse his shot. Why, then, not take the distance of each bullet-hole from the centre as the natural standard of merit? Let arbitrary bullseyes and artificial circles be made away with; let the distance of each shot from the centre be measured in the most convenient way; and let the mean of these distances (their sum, divided by the number of shots) be the test of merit. We have here a rational, simple, and fair system of marking, which requires no calculation beyond adding up a number of distances and dividing by the number of shots.

Practical Rules.

1. With a 1st class target the magpie circle affords the criterion of the admissibility of a shot. All direct hits within the magpie to count; all hits outside the magpie to be treated as misses. With 2nd and 3rd class targets the magpie circle may be used in the same way. It would be better, perhaps, to draw a circle with chalk of 3 ft. radius in the first case, and 2 ft. radius in the second, for the same purpose. Whatever square or rectangular target be used, a standard circle must be adopted,—the larger the better. The surface of this circle must be considered to be *the* target, the part of the actual target outside this circle being supposed to be non-existent. With a circular target, if there be such targets, the standard circle is of course the circumference of the target.

2. Misses (including the present outers) to be marked as 0.1 feet longer than the radius of the standard circle. Thus with a 1st class target (the magpie being the standard circle) all misses (including outers) would count as 3.1 ft.

3. The distances of the bullet-marks from the

centre to be measured in the most convenient way. If a number of circles differing by an inch or two in radius were marked or painted on the target, they would much facilitate the measuring.

4. If great accuracy be desired, both competitors should shoot with the same rifle. If preferred, each should fire half his shots with his own rifle, and rifles should then be exchanged; A firing the remaining half of his rounds with B's rifle, and *vice versâ*. This was the plan followed by M. Bertrand when carrying out his experiments. He had 10 men and 10 rifles; and each man fired 10 rounds with each rifle.[1] By this means the errors (however inappreciable) inherent in *all* rifles were equally distributed in the different scores.

5. As an example of the preceding suggestions, the shooting of A and B, already considered, is given after the proposed plan.

[1] "Calcul des Probabilités," Paris, 1889; p. 238.

A's Score.	No. of Shot.	B's Score.
Ft.		Ft.
1.12	1	0.9
1.12	2	0.9
1.12	3	0.9
1.58	4	1.8
1.58	5	3.2
1.80	6	2.46
2.23	7	3.53
2.06	8	2.23
2.06	9	2.90
2.12	10	3.53
16.79		22.35
1.68		2.23

By this test A again beats B, their mean errors being :—

A	B
1.68 ft.	2.23 ft.

III

THE PROGRESS OF FIELD ARTILLERY

THE invention of gunpowder and the invention of cannon are commonly spoken of as one and the same event; yet the two events are quite distinct, and are separated by a certain interval of time, the latter event being a consequence of the former.

Who invented gunpowder?

Before attempting to answer this question, it will be well to settle what is meant by gunpowder. Gunpowder is an intimate mixture of saltpetre, charcoal and sulphur, in certain proportions, which explodes violently and rapidly, but not instantaneously, evolving a large volume of gas. To this mode of explosion it owes the property which distinguishes it from other mixtures of the same ingredients,—that of projecting bodies in contact with it to considerable distances. In order to insure such an explosion, it is necessary that its three ingredients should be pure; the reason being (so far as saltpetre is concerned)

that impure saltpetre rapidly absorbs moisture from the atmosphere and deliquesces. The conclusion is that gunpowder could not have been known to any people unacquainted with the means of purifying saltpetre.

In his well-nigh exhaustive book, "Geschichte der Explosivstoffe," Berlin, 1895–6, Herr von Romocki demolishes the claim of the Hindoos to the invention of gunpowder and cannon, which he shows to be based upon the misinterpretation of certain Sanscrit terms.[1] They had incendiary mixtures and fireworks of various kinds, but not gunpowder.

The Chinese had an explosive as early as 1259 A.D. Their gun was made of bamboo, and could be fired only once; and the projectile was a mass of some incendiary composition, solely intended to set fire to what it fell upon. The next step, that of substituting metal for bamboo in the guns, the Chinese did not take;[2] a fact which adds great weight to Gibbon's "suspicion that the recent discovery (of metal cannon) was carried from Europe to China by the caravans of the 15th century, and falsely adopted as an old national discovery before the arrival of the

[1] i. 35–7.

[2] Romocki; i. 58.

Portuguese and Jesuits in the 16th."[1] The first guns from the West were looked upon with wonder by the Chinese, as something new and unheard of.

That the Arabs knew little or nothing of the use of saltpetre until the second quarter of the 13th century, is sufficiently proved by the absence of all mention of it before that time in the voluminous works of their philosophers.[2] Fire-arms are alluded to only once or twice in the "Arabian Nights," which cannot be dated much earlier than the year 1400 A.D., and "whenever they are mentioned, we must suspect the scribe."[3] The Crusaders describe no incendiary materials that were unknown to the ancients, although the terms they apply to the old machines and Greek fire may occasionally *seem* to refer to Artillery similar to ours. The Arabs had the Greek fire and fireworks and even primitive torpedoes,[4] but not gunpowder.

From an early period the Greeks paid much attention to incendiary mixtures, known to us

[1] "Decline and Fall &c.;" viii. 11.

[2] Romocki; i. 26. For example, Avicenna does not even mention the deflagration of nitre upon burning coals. Thomson's "Hist. of Chemistry;" i. 138.

[3] Sir R. Burton's "Thousand and One Nights," London, 1894; viii. 79.

[4] Romocki; i. 70-1.

under the generic name of Greek Fire, which appears to have been first prepared for them by one Kallinikos in 678 A.D. What the exact nature of this mixture was we do not, and probably will never know, because the composition was kept as a State secret. But there is no reason to suppose that it was gunpowder; for there is no evidence to prove that the Greeks were acquainted with the properties of saltpetre before the middle of the 13th century.[1]

Latin MSS. of the 14th and 15th centuries exist in several European Libraries which profess to be translations of a lost Greek original, the "Liber Ignium" by one Marchus the Greek. Herr von Romocki gives the Paris and Nürnberg versions *in extenso*, and also a German paraphrase which belongs to the Vienna Library.[2] Far from being an orderly treatise on gunpowder, the "Liber Ignium" is described by M. Fournier as "un tissu d'erreurs et un amas de recettes."[3] M. Désortiaux adds:—"le traité de Marchus Græcus n'a . . . aucune valeur au point de vue tech-

[1] Romocki; i. 33. "La poudre à canon n'est pas donc réellement le feu gregeois."—MM. Reinaud and Favé's "Controverse à propos du Feu Gregeois," Paris, 1847; p. 15.

[2] Romocki; i. 116–132.

[3] "Biographie Universelle," art. 'Marcus Græcus.'

nique."[1] The Paris version consists of 33 receipts, of which the 7th contains an unknown substance and the 33rd is unintelligible. Of the remaining 31 receipts, the 1st, 2nd, 3rd, 6th, 10th, 11th, and 26th are avowedly for war purposes,—"ad comburendos hostes tam in mari quam in terrâ, &c., &c.," — and are chiefly oleaginous, incendiary mixtures. The remainder are for magic lanterns, rockets, &c. No saltpetre is used in the first 11 receipts, which include 6 out of the 7 war-mixtures; and so far were fire-arms from the thoughts of the writer that he plainly says, if No. 11 be ignited it will consume whatever it may be projected into by means of a bow or a ballista ("arcu vel ballistâ projecta"). The only mixture of any interest to us is No. 13, because it consists of saltpetre, charcoal, and sulphur, and that too in proportions closely resembling some modern mixtures, as shown below:—

[1] "Traité sur la Poudre," Paris, 1878; p. 10.

TABLE G.

Ingredients.	Marchus' Mixture.[1]	Gunpowder, 16th Cent.[2]	Blasting Powder, present time.[3]	Rocket Mixture, present time.[4]
	Parts.	Parts.	Parts.	Parts.
Saltpetre .	66.6	66.6	66.0	64.0
Charcoal .	22.2	20.0	23.5	20.0
Sulphur .	11.1	13.3	10.5	16.0

A floury mass, composed of more or less impure ingredients, the mixture in col. 1 differed from the gunpowder in col. 2 which was composed of comparatively pure ingredients, and differed still more from the blasting powder in col. 3 which was made of very pure ingredients and was granulated in large grains. The mixture of Marchus was not gunpowder. Its use, as he tells us, was twofold: either to act as rocket composition, or to explode with a loud noise. For the first purpose, he directs the mixture to be tightly pressed into its case. When ignited, it fizzed

[1] Romocki; i. 118.

[2] "Certain Waies for the ordering of Souldiers in Battelray," London, 1560, P. Whitehorne; chap. 24.

[3] "Manual of Chemical Technology," London, 1892, R. von Wagner, trans. by Crookes; p. 388.

[4] "Pyrotechnist's Treasury," 1878, T. Kentish.

off like the mixture in col. 4. For the second purpose, he directs the case to be fortified by iron wire, and to be only half filled with the composition. When ignited by a small fuze, the gases generated by the combustion "gradually developed until the case burst with a report." The apparatus, in fact, was "a cracker of the present day."[1] There is nothing in the "Liber Ignium" to show that this Greek had any notion of such an explosive as gunpowder. Even if he had formed such a conception, he could not have realised it; because, as he informs us himself, the only method known to him of purifying saltpetre was of the most primitive nature,[2]—far inferior to that known to the Arab writer Hassan Er-Rammah, who wrote 1275–95 A.D.

That the two great alchemists, Albertus Magnus (1193–1280) and Roger Bacon (1214–1292) were acquainted with this "Liber Ignium" and freely borrowed from it, scarcely admits of a doubt; but they could not extract from it a knowledge its author did not possess,—a knowledge of the nature and distinguishing property of gunpowder. Yet they both appear to have possessed this

[1] "Manufacture of Explosives," London, 1895, O. Guttmann; i. 8–9.

[2] Romocki; i. 119–20.

knowledge.[1] Either of them, in the course of his experiments, may have made a casual use[2] of the pure ingredients, in proportions similar to those of Marchus; discovered the projectile property of the mixture; and communicated the result to his brother monk. Or they may have made the discovery simultaneously and independently, as Newton and Leibnitz invented the Differential Calculus, and Leverrier and Adams discovered the planet Neptune.

Who invented cannon?

It is impossible, from want of evidence, to give a trustworthy answer to this question; and we can only fall back upon the almost universal tradition[3] which attributes the invention to a German monk, one Berthold Schwartz.[4] The first

[1] With regard to Bacon, see Hallam's "Introduct. to the Literature of Europe, &c.," Messrs. Ward & Lock's ed., p. 57. Thomson's "Hist. of Chemistry;" i. 36.

[2] MM. Reinaud and Favé's "Controverse à propos du Feu Gregeois;" p. 15.

[3] For instance, the Byzantine historian L. Chalcocondyles, who wrote in the early part of the 15th century, "Hist. de orig. . . . Turcorum;" ii. 70–72. Guicciardini, writing in the early part of the following century, speaks of Artillery as "questa peste trovata molt' anni innanzi in Germania."—"La Hist. d'Italia," lib. i. p. 24, Venet. 1562.

[4] So far as can be discovered, this shadowy monk had nothing whatever to do with the invention of gunpowder:—"Schwartz, der zwar keinenfalls das Pulver erfunden."—Jähns' "Handbuch der Gesch. des Kriegswesens;" p. 773.

cannon of which we have undoubted evidence were those used by the Germans who besieged Cividale in Italy, 1331.[1]

To recapitulate: gunpowder came into existence almost simultaneously and, it may be, independently in China and Europe about the middle of the 13th century; its invention, in the latter case, being probably the result of the researches of either of the two famous alchemists, Albertus Magnus and Roger Bacon, or of both of them. Cannon, in the modern sense of the word, came into use in Europe during the first half of the 14th century, and may have been invented by the monk, Berthold Schwartz. The first use of Field Artillery was made by ourselves.[2]

Had the three small guns which Edward III. brought into the field at Crécy produced an effect at all commensurate with the expense of constructing and working them,[3] and the labour of moving them, Artillery would probably have soon attracted attention and shortly attained to as great a degree of perfection as the state of Chemistry

[1] Romocki; i. 80–1.

[2] "Die Engländer waren die ersten, welche Geschütz mit ins Feld nahmen."—Decker's "Gesch. des Geschütz, &c.;" p. 98.

[3] Gunpowder was long a costly article. "Parliament. Hist.;" ii. 665.

and Metallurgy permitted. Cavalry had about this time exchanged their hauberks for plate-armour which was proof against sword and lance thrusts, and even against battle-axes, and charges of Cavalry were in consequence irresistible. Any invention, therefore, which created a counterpoise to the overwhelming influence of the men-at-arms would have been gladly welcomed in the English army; for its chief strength lay then, as it has always lain, in its archers, its Infantry,[1] and it was engaged at the moment in a struggle with an army which possessed a brave and numerous Cavalry. But the feebleness of the powder, the weakness of the guns and the danger attached to their service, the inaccuracy and slowness of their fire, and the difficulty of moving them from place to place, showed how vain was the hope that the new arm could cope successfully with the men-at-arms. The effect it produced, however, was sufficient to ensure its retention in the English service, and its adoption in all others. It killed but few, perhaps;[2] but it terrified many. Indeed, one of

[1] "In pedite robur," as Tacitus says of the ancient Britons.

[2] Villani, however, who died only two years after Crécy, speaks of the "grande uccisione di genti e spondamento di cavalli" caused in that battle by the Artillery; quoted in Hallam's "Middle Ages;" i. 478.

the chief distinctions between ancient and modern war lies in the great importance which fire-arms conferred upon moral force. The battles of the ancients were generally of a simple type. The two armies met; a prolonged and desperate struggle, man to man, took place; physical strength prevailed; and the battle ended. But the race of brute force was run when gunpowder and cannon were invented. The guns could be loaded but slowly, and few of the shot may have struck the mark; but when the fatal ball did enter the ranks, havoc followed in its wake. No courage could avail against it, no armour was proof against it; it came from distances no archer could reach, and it came unseen. Once within cannon-range, every man felt himself every moment exposed to the invisible messenger of death.[1] In addition to this feeling, there was the reflection:—if the last cannon-ball was destructive, the next will be equally destructive,—it may be even more destructive. So argued the soldiery, and in some such way arose the moral force of Artillery, which, it is beyond all doubt, was very great. "In my opinion," said General Monro, in the 17th century, "the terrour the cannons breed

[1] Adam Smith's "Wealth of Nations;" Bk. v. ch. 1.

is as much to be feared as the execution that follows, though it be great."[1]

As time rolled on Field Artillery encountered various obstacles to its onward progress.

As early as 1139 the Church, through the second General Council of the Lateran, had forbidden the use of all military machines against Christians. This prohibition may have opposed but a trifling obstacle to the development of Artillery; but the Church seriously delayed its progress indirectly. The progress of Artillery obviously depends upon the progress of Chemistry, Metallurgy and the Mechanical Arts: the slower *their* progress, therefore, the slower *its* progress. Now the Church was the implacable enemy of all knowledge and culture from the rise of sacerdotal power to a quite recent period. "Innovation of every kind was regarded as a crime; superior knowledge excited only terror and suspicion. If it was shown in speculation, it was called heresy; if it was shown in the study of nature, it was called magic."[2] "The science of the Church is neglected for the science of Geometry," says Eusebius, the ecclesiastical historian, when de-

[1] "Munro his Expedition with the Scots Regiment," 1637; p. 211.

[2] Lecky's "Rise and Influence of Rationalism in Europe;" i. 275.

nouncing some harmless heretics; "they lose sight of heaven while they are employed in measuring the earth. Euclid is perpetually in their hands; Aristotle and Theophrastus are the objects of their admiration; and they express an uncommon reverence for the works of Galen." [1]

To stamp out all sparks of knowledge, the Church adopted the simple plan of imprisoning, or burning as magicians, the foremost chemists and men of science of the time. Many able men, doubtless, terrified by the fate of their leaders, abjured the study of so dangerous a science as Chemistry. Roger Bacon was imprisoned for years for his alleged practice of the Black Arts; Sylvester II.'s taste for physical science might have sent him to the stake had he not been Pope; Galileo, when Milton visited him near Florence in 1638, had "grown old, a prisoner to the Inquisition, for thinking in Astronomy otherwise than the Franciscan and Dominican licensers thought." [2] Spain, alone, was drained of her best and boldest intellects at the rate of 1000 annually for three centuries.[3] Under such a persecution "it is, indeed, marvellous that science should ever have

[1] Quoted in Gibbon, "Decline and Fall, &c.;" ii. 215–6.
[2] Milton's "Areopagitica."
[3] Darwin's "Descent of Man;" i. 179.

revived amid the fearful obstacles theologians threw in her way. Together with a system of Biblical interpretation so stringent, and at the same time so capricious, that it infallibly came into collision with every discovery that was not in accordance with the unaided judgments of the senses, and therefore with the familiar expressions of the Jewish writers, everything was done to cultivate a habit of thought the direct opposite of the habits of science."[1]

Mining was in a backward state, Metallurgy was in its infancy, and Chemistry (in *our* sense of the word) did not exist when fire-arms first appeared. The miner was unable to pierce through indurated strata until gunpowder supplied the means of splitting the hardest rocks; and mining could be carried on to only a limited depth until the steam-pump superseded the slow and ponderous hydraulic machines used for raising the water that accumulates in every mine. Although Agricola, who lived in the middle of the 16th century, may be looked upon as the founder of modern Metallurgy, the use of coal in the manufacture of iron was not attempted until the reign of Charles I. by Dudley; and was only finally

[1] Lecky's "Rise and Influence of Rationalism in Europe;" i. 274.

and successfully introduced, after many failures, by Darby in 1713.[1] Cort's patents for puddling and rolling are dated 1783–4, and the invention of the steam-hammer for the forging of large masses of metal was made by Mr. Nasmyth as late as 1838. Siemens' regenerating furnace was constructed in 1858–60, and Bessemer's splendid discovery of the method of converting cast iron into steel was made at the same time. The Latin Oration delivered at Cambridge in 1654 by Dr. Barrow shows that Chemistry was at that time just emerging from its mystic, or alchemical stage into the daylight of reason and common-sense;[2] and it was only raised to the dignity of a science by the labours of Becker in Germany and Boyle in England, a few years later. The gunpowder of the 14th and 15th centuries contained an excess of charcoal and sulphur, on account of the weakness of the guns; and, for the same reason, three different kinds of powder were used in the 16th century:—strong powder for small-arms, weaker powder for the field-guns, and still weaker powder for the heavy guns. "If serpentine (ungrained) powder should be occupied

[1] Scrivener's "Hist. of the Iron Trade," 1854; p. 89.
[2] Barrow's Works; ix. 35–47.

(used) in hand gunnes . . . it would scant be able to drive their pellets a quoit's cast from their mouths; and if hand gunne pouder should be used in pieces of ordnance, without great discretion, it would quickly break or marre them."[1] What *we* know as gunpowder dates no further back than 1815, when Sir William Congreve, R.A., took out patents for its manufacture.

The whole spirit of Chivalry was opposed to that of Artillery. The success of Artillery in action depends upon the patient co-operation toward one end of a number of men. Chivalry, "ignorant ou dédaignant l'art d'organiser et de diriger les masses, ne reconnâit et n'estime que la *prouesse*, mot ancien, mais très-expressif, pour indiquer un fait d'armes isolé, dans lequel l'heros doit plus à son courage et à sa force physique qu'á la réflexion."[2] Chivalry was not slow to denounce the new "artifice of Satan." Ariosto gives us one of the chief indictments:—

> "Per te il mestier dell' arme é senza onore,
> Per te é il valore e la virtù ridutta."[3]

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[1] Whitehorne's "Certain Waies for ordering Souldiers in Battelray," 1560; chap. 24.

[2] Rocquancourt's "Cours complet d'Art, &c. Militaires;" i. 234.

[3] "Orlando Furioso;" xi. 26.

Don Quixote follows with others. "The devilish instruments of Artillery" enable a "base cowardly hand to take the life of the bravest gentleman. . . . A chance bullet, coming nobody knows how or from whence, fired perchance by one that fled affrighted at the very flash of his villainous piece, may in a moment put a period to the vastest designs."[1] Very similar were the opinions of the warrior, "perfumed like a milliner," which Hotspur quotes in 1 *Henry IV.*; i. 3. We must not, of course, take the phrases of such writers too literally; but we may be sure that popular authors would not have ventured to utter such sentiments had they not known that the public were with them.

In opposing the Artillery the Priests and Knights were joined by strange allies,—the Mercenaries.

The use of mercenary troops began with the Solidarii of the 11th century, who, rapidly increasing during the following two hundred years, were commonly employed in the 14th and 15th centuries. For these marauders, the live ass was

[1] Pt. I. Bk. iv. ch. 11. These words, although put into the mouth of the crazy Knight, may represent more or less the opinions of Cervantes himself, who was a soldier and lost a hand at the battle of Lepanto, 1571.

better than the dead lion. A dead man, whatever his rank, was only worth his armour and what money there might be on him; but from the wounded knight or captured burgess they could and would extract a heavy ransom. As a matter of course they were opposed to the use of an arm which struck down the rich and the poor alike. To such a length was the system of capture and ransom carried that at the battle of Zagonara, 1423, only three men were killed, and these three by suffocation in the mud into which they fell, when exhausted by fighting and the weight of their armour. At the battle of Mollinella, 1467, no one was killed; and in an action between the Neapolitan and Papal troops in 1486, which lasted all day, no one was killed, and it is not recorded that any one was wounded.[1]

The amount of *matériel* necessary for the equipment of a given force of Artillery is out of all proportion to the quantity required for a corresponding force of Infantry or Cavalry. In the Middle Ages, when every peasant was master of a bow or sword, and every gentleman possessed a horse and armour, it was easy to assemble at a moment's warning an army of knights and archers;

[1] Hallam's "Middle Ages;" i. 477.

but Artillery could form no part of these hasty levies. It is impossible to improvise this Arm on a sudden emergency: the guns, the carriages, the ammunition had, even in the rudest periods, to be constructed and guarded with care in time of peace, to enable them to appear upon the field in time of war. Trained gunners, too, were indispensable, and time and care were needed to educate them. Horsemanship, the use of the sword and archery might be acquired by private individuals, but a knowledge of gunnery was restricted to those who had access to guns; and guns, owing to their cost, could only belong to governments or great nobles.[1] This state of things was prejudicial to the progress of the Arm. Few rulers or nobles possessed a treasury capable of supporting a force of Artillery in time of peace; and the spirit of the age and the nature of feudal obligations were opposed to the existence of standing armies.

Retarded by these influences, the progress of Field Artillery was almost imperceptible at first; and it was not until the close of the reign of Louis XI. of France, or the beginning of that of

[1] For an account of Edward III.'s financial difficulties in the Crécy campaign, see Longman's "Life, &c. of Ed. III.;" i. 116–153.

Charles VIII., 1483, that wheeled carriages were introduced for the guns, which previously had been carried in carts.[1]

Guns could now move, although with difficulty, and Charles VIII., Francis I., and Henry IV. of France did much with their Artillery,—especially the latter. They might, and no doubt would have done more with a better *matériel;* but movements in the field were very seldom practicable owing to the massive and misshapen gun-carriages and the clumsy and unserviceable wheels. The military history of the 15th and 16th centuries shows that the gradual improvements in Artillery were almost exclusively confined to the fire of the guns. The importance of a powerful fire was manifest to every one; the value of mobility had not yet suggested itself to anybody.

The gradual manner in which the new arms supplanted the old is well illustrated by the operations of the Turks in Cyprus in the second half of the 16th century. Previous to the siege of Nicosia, 1570, the Venetians had a force of Cavalry and Mounted Infantry,—musketeers on ponies,—to hold the open country. Both parties had cannon,

[1] Favé's "Hist. et Tact. des Trois Armes;" p. 12. Grewenitz', "Traité de l'Org., &c. de l'Art.;" p. 28.

and the Turks opened the siege by a heavy discharge of musket balls and arrows. At the siege of Famagusta, in the following year, the Turks had mortars as well as guns, and supplemented their musketry fire by a shower of arrows shot very high, so that they might fall upon the heads of the besieged behind their ramparts. The latter, in addition to a fire of guns and muskets, made use of Greek fire, pouring it upon the heads of the columns of attack with much effect. They also threw hand-grenades, filled with fine powder, which killed 'many persons at once.'[1]

In 1611 Gustavus Adolphus ascended the Swedish throne, and ere many years had elapsed he reorganised the Infantry service, and opened a new future to the Artillery by radical changes both in its *personnel* and *matériel*.

All the military writers of his time notice the excellence and skill of his gunners. "By the Art of gunnery and good Artists the Artillery hath gained Battels . . . and Forts," says an old English gunner, "yea, the strong Trenches of a strong Army: which was seen at the Battel of Lützen in Nov. 1632. . . . For there the Swedes

[1] Diedo's "Hist. of the Repub. of Venice;" ii. 228 *et seq.* Paruta's "Storia della Guerra di Cipro;" p. 88 *et seq.*

Gunners did so artificially ply their Ordnance that the Swedes Army stormed the Imperialists in the most secure Trenches that could be made, and a stronger Army within than that without; and only by the Artificial and Industrious Carriage of the Gunners."[1]

With regard to the *matériel*, the three great changes introduced by Gustavus were; first, the division of Artillery into its two natural branches, Field and Siege Artillery, by remanding all guns of a greater calibre than 12 Prs. to the latter branch; secondly, the distribution by twos of a number of field-guns among the battalions of Infantry; and thirdly, the introduction for this purpose of the very light guns invented by Col. Wurmbrand, called 'leather guns.'[2]

The first step, simple as it may seem, was a stroke of genius, and completely justifies us in calling Gustavus the founder of modern Field Artillery.

The second step, although necessary perhaps at the time, laid the foundation of a radically bad system which lasted for a century and a half, and

[1] Capt. Thos. Binning's "Light to the Art of Gunnery," 1689; Introduction.

[2] "Geschichte des Geschützwesens, &c.," Major C. von Decker, Berlin, 1822; p. 51.

which, at the present moment, shows some signs of revival in another form. The evils of this system ought to be clear enough to us; but Gustavus could not divine its latent weaknesses, which only developed themselves when the rapidity of Infantry manœuvres had been greatly increased by Frederick the Great, more than a century afterwards.

The Battalion guns, which were retained in Germany and adopted in England after the Thirty Years' War,[1] attracted the attention of the French Court in 1736; and in 1756 they were introduced into the service, in spite of the opposition of all French Artillery officers of note except M. du Brocard.[2] Some of these guns were dragged along by men; others by one or two horses. The former, of course, seriously encumbered the Battalions they belonged to. Infantry compelled to draw guns with them could not march, even on smooth and level plains, with the same order and rapidity as Infantry free from such hindrances; and in a cultivated country intersected by ditches, fences

[1] The Royal Warrants, dated Windsor, 8th August 1686, and 5th June 1687, show that 3 Pr. brass guns were then used as Battalion guns.

[2] "Lettres d'un Officier du Corps Royal de l'Artillerie au Lieut. Col. du Régiment D.," Paris, 1774; pp. 3, 10.

and walls, the guns had generally to be abandoned altogether.[1] On the other hand, posted generally in the centre of the Battalion, the guns were continually placed in positions most unfavourable to the effect of their fire; and as they took part in the movements of the Battalion, the necessary time was not afforded to the gunners for placing, loading and laying them carefully.[2] The command of a Battalion carries with it quite as much responsibility as one man is equal to; but these guns, especially if horsed, materially added to a commander's cares. He was responsible for the efficiency of the gunners, the supply of ammunition, the state of the carriages, the condition of the harness, and the feeding and shoeing of the horses.[3] Whether drawn by men or horses, the constant presence of these guns led the Infantry soldiers insensibly to look upon them as necessary to the safety of the Battalion, and thus diminished the self-confidence which Infantry must possess to be successful. "Ce malheureux sentiment n'est déjà que trop répandu," wrote a French

[1] "Ueber Reitende Artillerie, was sie ist, sein sollte, und sein könnte," by Monhaupt, Leipsig, 1818; p. 32.

[2] Dupuget's "Essai sur l'usage de l'Artillerie," Amsterdam, 1771; p. 7.

[3] Decker's "Gesch. d. Geschütz., &c.;" p. 52.

officer in 1771.[1] Finally, this bad system weakened the Artillery without strengthening the Infantry; for it deprived the columns or trains of Artillery of a large number of guns which, if grouped together under their own officers, might have been turned to good account.[2]

In order that these guns should be capable of accompanying their Battalions, it was necessary that they should be very light; and it was for this reason that Gustavus Adolphus introduced the so-called leather guns. Their existence, however, was short-lived; for they heated so rapidly, owing to their construction, that they had to be allowed to cool after every 10 or 12 shots.[3] Accordingly, they were soon replaced by 4 Pr. iron guns of $5\frac{1}{2}$ cwt., which as a general rule fired case (of musket-balls).[4] These were the guns called by the French "pièces à la Suédoise."

During his Polish wars the great mobility of the leather guns enabled Gustavus to use them

[1] "Réflexions sur la pratique du Pointement du Canon," Amsterdam, 1771; p. 58.

[2] "Cinquante pièces de 4 ajoutées à l'Artillerie d'un parc . . . feront plus de mal aux ennemis et contribueront plus à la réussite des actions de guerre que les 160 attachées constamment aux Bataillons."—Ibid., p. 57.

[3] Tempelhof, quoted by Decker, "Gesch. d. Geschütz., &c.;" p. 51.

[4] Ibid., p. 52.

with success against the Polish Cavalry: in all his battles he handled his Artillery like a master. But—"Gustave n'apparut que pour un jour, pour montrer une science nouvelle, vaincre, périr."[1] He was killed by the enemy, or murdered by a friend, at Lützen, 1632. The fame of his light Artillery, however, had spread abroad, and it was more or less adopted by most of the great Powers.

As a strong Brigade of Scots (with whom was Captain Dugald Dalgetty) served under the great King, it is not surprising to find that the Scottish army had leather guns at the affair of Newburn, 1640; when they crossed the Border under "that old, little, crooked soldier," Alexander Leslie. On this occasion the leather guns occupied an excellent position to which ordinary guns could not have been dragged; and when they unexpectedly opened fire, the English were panic-stricken. "Some thought it magic, and all were put in such disorder that the whole army did run with so much precipitation that Sir Thomas Fairfax, who had a command in it, did not stick to own that till he crossed the Tees his legs trembled under him."[2] Here we have a good example of the great moral

[1] Michelet.

[2] Bishop Burnet's "Hist. of My Own Times;" Bk. i.

effect of even feeble guns, when enabled by their mobility to occupy a decisive position at a critical moment.

Two years later the Great Rebellion broke out. We find occasional mention of the use of leather guns during the war; but they soon fell into disrepute, as they had done elsewhere, and Binning speaks of them as guns "by which the King and the Country hath been cheated."[1] "They are light," says Sir James Turner, "which is the greatest advantage they have."[2] It was the only advantage they had; and to profit by this solitary advantage it was indispensable that they should be commanded by skilful officers and trained gunners. But such officers and men were nowhere to be found. Owing to a long peace, 'the silver streak of sea,' and the want of proper means of instruction, the *personnel* of the English Artillery was in a very backward state.

In the latter half of the 15th century we find traces in England of a special and permanent body of officials—Master-Gunners and Gunners—in the very few places where it was thought necessary to

[1] "Light to the Art of Gunnery," 1689 (but written years before); p. 104.

[2] "Pallas Armata," 1683; p. 189.

keep up a show of defence.[1] Master-Gunners must have been well-known functionaries at an early period, for Shakespeare makes the Master-Gunner of Orleans one of the *dramatis personæ* in 1 *Henry VI.*, a play written at the close of the 16th century. But these men were civilians. When war was resolved on, the Ordnance officials sent in for approval a list of guns, stores, &c., together with the names of the "officers, ministers, and attendants" proposed for employment;[2] but there are no grounds for supposing that these ministers and attendants were more than arsenal storekeepers and workmen. In a list of a number of men appointed Master-Gunners by Queen Elizabeth, which specifies their occupations, only two are described as 'soldiers;' the rest,—the vast majority,—were civilians.[3] A document dated 16 July 1682, describes the fee'd gunners of the Tower as "ordenary labourers employed in the office of H.M.'s Ordnance."[4] The gunners were only brought under military discipline by a Warrant dated 22d August 1682,[5] and "so recently

[1] Hallam's "Const. Hist. of England;" ii. 131.

[2] "Essay on the Regl. Hist. of the Royal Artillery," Lieut.-Col. F. Miller, *V.C.*, R.A., Woolwich, 1867; p. 6.

[3] Col. Duncan's "Hist. of the Royal Artillery;" i. 39.

[4] Col. Miller's "Essay, &c.;" p. 5.

[5] Duncan's "Hist. of the Royal Artillery;" i. 60.

as 24th January 1783, the Establishment Warrant of the Ordnance reckoned the Master-Gunners as part of its 'civil' establishment."[1]

The instruction received by these gunners from the Master-Gunners, once a month in winter and twice a month in summer,[2] was wholly inadequate to qualify them for their office, even had the Master-Gunners been always competent instructors. "Englishmen have had but little instruction" (in gunnery) "but that they have learned of the Dutchmen or Flemings in the time of King Henry VIII.," says a Master-Gunner of the 16th century.[3] He seems to think that the necessity of importing these foreign instructors arose from the lax system pursued in selecting the Master-Gunners, for he adds:—"a number of men take upon them to be gunners, yea and that Master-Gunners, that are not sufficient nor capable . . . but are altogether ignorant, standing upon no other thing but their antiquitie, that they have served as gunners so long time." There is no exaggeration here. A document exists showing that the ages of some of the Tower gunners in the time of Elizabeth ranged

[1] Clode's "Mil. Forces of the Crown;" i. 8.
[2] Walton's "Hist. Brit. Standing Army;" p. 724.
[3] Bourne's "Art of Shooting in Great Ordnance,' 1587; pref.

from 64 to 92 years.[1] When the Great Rebellion broke out, some of the Master-Gunners, such as Eldred of Dover and Nye of Worcester,[2] were really able men; but the gunners were bad, chiefly, no doubt, because the Master-Gunners had no military control over them. A year after the war began, Norton refers to "the penury of expert gunners;"[3] and Eldred with 30 years' experience as Master-Gunner of Dover Castle, complains loudly of "the idle lazinesse of the Gunners, that had rather spend their time potting and canning[4] than in the knowledge of their Peeces or practice of their Profession. . . . I do verily think that a Fort or Hold that is pestered and cloyed with unskilful and obstinate Gunners were as good be furnished with so many Traytors."[5] It is now clear why the military writers of the period, without exception, speak of an army as composed of Infantry and Cavalry only. The Artillery proper,

[1] Col. Miller's "Essay, &c.;" p. 4.

[2] Nye explains how to fire a gun by steam, "Art of Gunnery," 1647, p. 30, sixteen years before the Marquis of Worcester proposed to "drive up water by fire" in his "Century of Inventions," 1663.

[3] "The Gunner's Dialogue, &c.," 1643; dedication.

[4] "*Brainworm, disguised as a Sub-officer*:—You may do the part of a kind gentleman in lending a poor soldier the price of two cans of beer. . . . The King of Heaven shall pay you, and I shall rest thankful."—Jonson's "Every Man in his Humour," 1598; ii. 3.

[5] "The Gunner's Glasse."

the Master-Gunners, with their Mates and Powder-boys, were looked upon as mechanics and skilled artificers,—or Artists, as they preferred to call themselves.[1]

The Ordnance officials had, of course, some control over the gunners after the Warrant of 1682; but their position was so doubtful that a clause had to be inserted in their commissions in 1694 to place it beyond doubt.[2] This clause defined their position in regard to the gunners, but it by no means converted them into combatant officers in the eyes of the army at large. As late as 1766 the Infantry at Gibraltar disputed the right of an Artillery officer to command the Garrison in the absence of the Governor, and the question was referred to the military authorities at home, who decided in the Artilleryman's favour.[3]

The bestowal of military commissions upon the Artillery officials in 1694 was followed by the for-

[1] "Let not the best Artist that is ever think to hit a mark alway at such a distance."—Ibid.; p. 72. Eldred was probably not aware of the danger of missing a mark too often. During the siege of Regensburg, 1634, just 12 years before he published his book, an Artist was hanged by order of Ferdinand, King of Hungary, for missing a tower 20 shots running. Decker's "Geschichte des Geschützwesens, &c.;" p. 92.

[2] Walton's "Hist. Brit. Standing Army;" p. 731.

[3] Col. Miller's "Essay, &c.;" p. 4.

mation of a permanent force of Artillery in 1716;[1] but the officers did not take kindly to military rule. Civilians are not to be transformed into soldiers by a stroke of the pen: a Warrant can alter a man's condition, but it cannot change his nature. It was not until the Flanders campaigns of 1748–9 that the Artillery began to assume a military appearance. Our evidence upon this point is that of General Forbes Macbean, an able man who cannot have been mistaken about what took place under his eyes. It was then, he says, that the corps "began to bear a regular military appearance; great attention was paid to good order, strict discipline and subordination—a change that was far from agreeable to the older officers, . . . but the junior officers, who had of late been promoted from the Cadet Company . . . entered with great zeal and military spirit into the newly adopted alterations and improvements."[2]

The course of events among the Artilleries upon the Continent was very similar. The officers of the French Artillery before Louis XIV.'s time (1643) were only officers in the sense that they held an office. They were with-

[1] Two Companies, 26 May 1716; which became on the 1st April 1722, the Royal Regiment of Artillery; ibid. pp. 13, 15.

[2] Cleaveland MSS. in R.A. Institution; p. 236.

out rank in the army, and had no troops under their command. Only when war actually broke out were these officials united and supplied with the necessary *matériel.* At length Vauban protested against their position as helpless civilians, and they received military rank when Vallière reorganised the Artillery in 1732.[1] We may rest assured that "had anyone in the service (in those times) ventured to assert the claims of the Artillery to be considered as . . . a substantive . . . part of the combatant force, he would have been laughed to scorn."[2]

Who, then, were the officers who commanded the guns before the Artillery officials obtained military rank? It is not easy to say:—the guns appear to have been made over on occasion to the first officer who came to hand. Take, for example, two of the opposing Batteries, French and English, at the battle of Estinkerke, 1692. Captain Mackraken of the Royals, an excellent shot, appears to have commanded the English Battery, and "had great success in laying the guns;" while the French Battery, "under a Commissariat officer, never threw away a shot."[3] Some few of the

[1] Favé's "Hist. et Tact. des Trois Armes;" pp. 105–6.
[2] Walton's "Hist. Brit. Standing Army;" p. 729.
[3] Ibid. p. 733.

officers who commanded Artillery, in peace or war, may have been originally Master-Gunners; but many others, certainly, had had no previous connection with this service. Consider the career of the first Colonel of the Royal Artillery, Albert Borgard. He began his services in 1675 as a Cadet in the Queen of Denmark's Regt. of Foot; in 1688 he left the Danish service and served as a "volunteer" in the Polish Army; in 1689 he became a Lieutenant in the Prussian Foot-Guards, and was put in command of two mortars at the siege of Bonn; in the same year he was employed as an Engineer; and in 1692 he became a Firemaster in the English Artillery.[1] The careers of many others, doubtless, were of the same type.

We can now understand Eldred's meaning when he says:—"I see few Captains that are gunners;"[2] and Binning's when he says:—"it was no wonder to see our common gunners so slothful to attain to perfection in Art, because if there had been a man able in his profession, our officers of Artillery would not employ him, lest he should see and so reveal their own in-

[1] "War Services of Lieut.-General Borgard," "Proceed. R.A. Inst.;" XIII. p. 129, *et seq.*

[2] "Gunner's Glasse;" p. 6.

sufficiency."[1] The officers in question were not "officers of Artillery" in *our* sense of the phrase. The charge of ignorance preferred against them was only too true probably; but in justice to them we must remember that they had little or no means of instruction. Another century was to pass away before the establishment at Woolwich of an Academy for the education of the officers of a scientific corps.

The following Table, H., will enable the reader to form some notion of the progress of S. B. Field-guns from the middle of the 17th century to middle of the present century.

TABLE H.

Gun.	Weight of Shot.	Weight of Gun.	Length of Gun.	Calibre.	Windage.	Charge.	Point-Blank Range.	Muzzle Velocity.
	Lbs.	Cwt.	Ft.	Ins.	Ins.	Lbs.	Yds.	F.s.
Demi-Culverin[2]	9	17.8	10	4.3	.25	6.25	175	1140
9 Pr. S.B., 1862	9	13.5	6	4.2	.1	2.5	300	1613
Saker[2]	4.75	12.5	9	3.58	.25	3.25	163	1050
6 Pr. S.B., 1862	6	6.0	5	3.6	.1	1.5	310	1483

[1] "Light to the Art of Gunnery;" introduction.
[2] Walton's "Hist. of Brit. Standing Army."

The great length of the old guns was a consequence of the use of slow-burning powder. In short guns, a large part of the charge would have been blown out unburnt. The use of slow-burning powder was necessitated by the weakness of the metal of the guns, as before explained.

Owing to the comparative ease with which bronze is manipulated, it might be supposed that the first guns were made of this material. Such was not the case however. The earliest cannon, *pots de fer*, bombards and the like, were constructed of wrought iron bars welded together and strengthened by external rings of the same metal. Bronze, or brass, does not seem to have been utilised for half-a-century after the introduction of cannon; nor were bronze guns made in any numbers for a century afterwards. The bronze guns known as the "Twelve Peers of France" date from the time of Louis XI. (1461–83). Bronze ordnance were not made in this country until a much later period. "This year (1535) John Owin began to make brasse Ordinance," says Stow. "He was the first Englishman that ever made that kind of Artillerie in England."[1] Before the reign of Louis XII. the

[1] "Annals;" p. 571.

Germans had discovered the method of manufacturing cast-iron, and as time went on guns were constructed of this material in ever-increasing numbers. In 1543, says Holinshed, "the first cast peeces of iron that ever were made in England were made at Buckesteed, in Sussex, by Rafe Hoge and Peter Bawd."[1] Bawd and Collet at the same time constructed "morter pieces from 11 ins. unto 19 ins. wide . . . and hollow shot of cast-yron, to be stuffed with fireworks, or wild fire; whereof the bigger sort had screwes of yron to receive a match . . . that the firework might be set on fire for to breake in smal pieces, whereof the smallest piece hitting any man would kill or spoile him." From that time until the middle of the present century the manufacture of guns from both materials continued, cast-iron being used for large and bronze (or brass) for field guns. About 1860 a complete change took place, and we reverted suddenly to the original method of building up wrought-iron guns,—under very different circumstances however. Nasmyth's steam-hammer had replaced the simple blacksmith's hammer; the primitive foot-blast had given way to the elaborate furnaces of Siemens and others;

[1] "Chronicles;" ii. 960. [2] Stow; p. 584.

and, owing to the great discovery of Bessemer, wrought iron was in a few years supplanted by steel.

For a long time after the invention of gunpowder the proportions of its ingredients were quite unsettled: Tartaglia gives no less than 23 receipts for its composition. The first great step in its manufacture, that of 'corning' or granulation, was probably taken in the first half of the 15th century.[1] This corned powder was used for small-arms only; ungrained, or serpentine, powder was used for Artillery; and we are told that "2 parts of corn-powder (would) do as much as 3 parts of serpentine."[2] By the time of the Great Rebellion the metal of the guns was so much improved in quality that serpentine powder was only used for priming. "There was in ancient time a kind of powder called serpentine," said Eldred in 1646, "not corned as the powder that we use in these days."[3] It is certain from Dryden's "Annus Mirabilis" that Charles II. took great interest in his Artillery and ammunition:—

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[1] Romocki; i. 182–3.

[2] "Art of Gunnery," T. Smith of Barwycke-upon-Tweed, Souldyer, 1599; p. 26.

[3] "Gunner's Glasse;" p. 25.

"Our careful monarch stands in person by,
His new-cast cannons firmness to explore;
The strength of big-corned powder loves to try,
And ball and cartridge sorts for every bore."

It is equally certain that about the middle of the 17th century some considerable improvement took place in England in the manufacture of powder, for the weight of the guns became notably greater than heretofore. "A culverin that shot 16 lbs. of iron," says Sir James Turner, "had but 100 lbs. of metal allowed for every lb. of her shot, and so she weighed but 1600 lbs.; but now (1670–1), and long before this, she weighs 4320 lbs., and consequently hath the allowance of 270 lbs. of metal" to each pound of the shot.[1] Chemistry, for the moment, had evidently outstripped Metallurgy. The weight of the field-guns, coupled with the drowsy and dilatory movements of the Infantry, was the chief cause of the system known as "the wars of position."

From the invention of corning until the year 1686, all the Great Powers made use of at least two kinds of powder,—one for the Infantry and the other for the Artillery. In this year the French took the retrograde step of making but

[1] "Pallas Armata;" p. 189.

one kind of powder for both services, although in the previous year a Frenchman had invented the mortar *éprouvette,* which sufficiently indicated the necessity for two powders.[1] The only explanation I can offer for this extraordinary procedure is, that appointments in the French Arsenals were obtained then, and long afterwards, by interest, not by merit. To this cause must be ascribed the inefficacy of the French ammunition in 1870, which reflects discredit upon the manufacturing departments only. Some of the hostile criticisms directed against the regimental officers and men of the Field Artillery appear to me to be unfair and unfounded.

Tartaglia, although ignorant alike of the laws of falling bodies and of the nature of the resistance of the air, ventured to maintain that the path of a projectile was curved throughout.[2] Galileo was not much better acquainted with the resistance of the air; but having discovered the laws of falling bodies, he confirmed Tartaglia's guess by showing that *in vacuo* a projectile would move in a parabola. Newton proved the general theorem, that a body projected in any way *in vacuo,* if acted upon by a central force varying inversely as the square

[1] Decker's "Gesch. d. Geschütz., &c.;" p. 25.
[2] Jevon's "Principles of Science;" p. 466.

of the distance, would move in a conic section. Experiments with small bodies dropped from the dome of St. Paul's enabled him to appreciate the resistance offered by the air to bodies moving with low velocities; but he had no adequate knowledge of its resistance to bodies with high velocities. Armed with Newton's results and with the proper means for experiment, Robins, by his invention of the Ballistic Pendulum and subsequent "careful and sagacious experiments,"[1] placed practical Artillery upon a sound scientific basis in 1742.[2] The results obtained by the pendulum, while showing the enormous resistance of the air to projectiles with high velocities, confirmed those previously obtained by the mortar *éprouvette*, and it became certain that large grain powder was the proper powder for guns, and fine grain for muskets.

The projectiles used during the Great Rebellion included round shot of iron and stone, grape and probably case. The Cavaliers when besieging Gloucester used "red hot iron bullets which in the night appeared like shooting stars."[3] At the same siege one of their shells, or 'grenados,' fell into a street near Southgate; "but a woman

[1] Dr. Whewell's "Hist. of the Inductive Sciences;" ii. 57.
[2] In his "New Principles of Gunnery."
[3] Rushworth's "Collection of Tracts, &c.;" v. 85.

coming by with a pail of water threw the water thereon and extinguished the phuse thereof, so that it brake not."[1]

It is extremely difficult to gain an accurate notion of the shooting of the guns of this period, owing to the loose way in which writers register the results of practice and the absence of records of consecutive rounds fired under the same conditions. In fact, the only record of such practice that I am acquainted with is that of 7 rounds fired by Master-Gunner Nye on the sands at Deal with the same gun, charge and elevation, presumably about 1640.[2]

TABLE I.

GUN.	No. of Rounds.	Charge.	Elevation.	Mean Range.	Prob. Error of Mean Range.	Prob. Error in range of one shot.	DATE.
		Lbs.		Yds.	Yds.	Yds.	
9 Pr. S. B. .	9	2.5	1°	714	18.4	55.4	1858
6 „ „ „ .	11	1.5	1¼°	688	16.2	52.6	1856
4¾ Pr. Saker .	7	3.0	5°	703	7.5	20.0	1640

Such was the state of the English Artillery during the 17th century.

[1] Vicars' "Jehovah Jireh," 1646; i. 402.

[2] "Art of Gunnery," p. 31. The Probable Errors given in Table I. illustrate the correctness of the ordinary expression for the probability of a small error in range,—R cot ϕ, where R is the range and ϕ the angle of descent.

It is unnecessary to touch upon the long wars of William III. and the Duke of Marlborough, because no change in principle was made in any Artillery during their course. Minor improvements in small matters doubtless took place; but they were unimportant, and we know little about them. The experience gained in these wars, however, convinced thoughtful officers that an efficient Field Artillery must be able to move as well as to fire. In consequence, a variety of proposals were made ere long for the construction of guns which (it was supposed) would combine lightness with efficacy of fire.

Among the first of these numerous proposals was that of the Chevalier Folard, who undertook to solve the great Artillery enigma,—"de diminuer la longeur des canons, et par consequent leur poids immense, aussi bien que celui de leurs affûts, sans préjudice de leur portée et de leur effet,"[1]—by a 24 Pr. gun; length, 2 ft. 4 ins.; weight, 15.1 cwt.; charge, 6 lbs. This gun was much lighter than the ordinary 24 Pr.; length, 11 ft.; weight, 45.5 cwt.; charge, 12 lbs.; but it failed in shooting power,—a large percentage of the charge, no

[1] Daniel's "Hist. de la Milice Française," Paris, 1724; i. 327, 330.

doubt, was blown out unburnt. Disgusted at the failure of his gun, Folard jumped to the conclusion that modern Artillery was beyond the reach of improvement; wrote several folio volumes of commentaries upon the history of Polybius; and proposed the introduction of the machines of the ancients. To reduce his theory to practice, "il avait fait construire une catapulte dont les expériences le transportèrent d'admiration."[1]

While the Chevalier was at practice with his catapult, the West-Germans were busy constructing a light Field Artillery. In his "Maximes . . . sur l'Art Militaire," published at Paris in 1726, the Marquis de Quincy speaks of newly invented guns, "courtes et carabinées," which were then in use east of the Rhine.[2] They were of two calibres, 8 Prs. and 4 Prs., and were mounted on carriages without limbers, constructed so that the guns might be fired without detaching them from the horses. Their efficacy of fire was inferior to that of ordinary guns of the same calibre, and their use entailed various serious inconveniences; but Quincy inclines to the opinion that the balance of advantages was in their favour, because their lightness more than compensated for

[1] "Biog. Universelle."

[2] Pp. 323, 325.

the weakness of their fire:—"on peut manœuvrer ces pièces devant un ennemi sans avantrain, en y attelant quelques chevaux qui les traineroient avec facilité en quelque terrain que ce fût. . . . Cette nouvelle manière donneroit le moyen à un Commandant d'Artillerie de suivre la Cavalerie, quand même elle iroit au trot." The galloper guns, which came into use some short time afterwards, belonged to this family. In 1747 the Duke of Cumberland had six 1½ Pr. gallopers in Germany,—blunderbusses on wheels,—"such as are now (1799) fired in St. James' Park on rejoicing days."[1] The carriages were made with shafts, so as to be drawn without a limber, the shafts acting as a trail when the gun was in action. Not a hint is given as to the means of transporting the gunners and the ammunition with their guns. Yet to send forward guns against an enemy without their ammunition and gunners may be compared to hurrying off the doctor's carriage and instruments at speed to the patient's house, leaving the doctor to find his way there as best he can on foot. Field Artillery is a complex whole, formed by the union of guns, ammunition and gunners, and no

[1] "British Military Library," 1799; vol. i., art. "Hist. Royal Art." Mr. Gleig rightly calls these pieces "a mere paterero," and adds that they were quite useless.

system can be said to possess real mobility which does not enable the three elements to be moved together.

No one had a higher opinion of Field Artillery, as it might be, than Marshal Saxe;[1] no one took a more despairing view of it as it was. It is most unlikely that the Artillery will ever move faster, thought the Marshal; it is impossible that it can ever move slower.[2] Starting from these assumptions, he virtually proposed to convert the existing guns into guns of position, and to create a light Field Artillery to supply their places. The new piece was to be an *amusette*, invented by himself, carrying a ½-lb. lead ball and drawn by one man. He is not explicit about the calibre of the ordinary guns, but he seems to incline to 16 Prs. He distinctly insists, however, upon their being drawn by oxen, for the following reasons:—first, oxen cut up roads less than horses; secondly, oxen cost less; thirdly, they can live upon almost anything; fourthly, they require little harness and no groom-

[1] "L'Artillerie de campagne feroit la principale force des armées ajourd'hui, si l'on y donnait plus d'attention." Quoted in Bonneville's "Esprit des Lois de la Tactique," 1762; i. 40.

[2] "Combien de fois les equipages restent-ils en arrière, aussi-bien que le train d'Artillerie, ce qui vous met dans la necessité de rester-là tout court!"—"Rêveries, &c.;" i. 147.

ing; and lastly, "si un bœuf s'estropie, on le tue, on le mange, et en prend un autre au depôt."[1]

Meanwhile Captain von Holtzmann was constructing a light field gun for Frederic William of Prussia. A number of these pieces, which had cylindrical, or conical chambers for the charge, passed into the Prussian service between 1740 and 1758; but they were finally discarded owing to their ineffective fire and the difficulty of loading them.[2]

About the same time the Russians introduced the peculiar guns called Schuwalows, which were organised with a view to their acting with Cavalry.[3] They were small, chambered 5 or 6 Prs. with an elliptical bore, the major axis being horizontal to facilitate (as it was supposed it would do) the lateral spread of the case they fired.

In the various attempts to improve the Field Artillery which I have mentioned, it will be observed that the organisation of the means of draught,—the drivers, horses and harness,—were wholly overlooked. Yet facts were continually

[1] Rêveries, &c.; i. 148.

[2] Gen. von Troschke's "Die Beziehungen Friedrich des Grossen zu senier Artillerie," Berlin, 1865; pp. 7, 28.

[3] Gen. von Strotha's "Die König. Preuss. Reitende Artillerie;" p. 1.

thrusting upon men's notice their utterly unserviceable condition. Marlborough was perpetually complaining to the Dutch authorities of the absence of his means of draught.[1] At Fontenoy, 1745, our Infantry, massed in deep column, were hampered in their movements and delayed under a shattering fire of cannon and musketry by their field pieces which they had to drag by hand.[2] "The cannon lost," says the 'Gazette' of the day, "was left behind for want of horses, the contractors with the Artillery having run off with them so early that they reached Brussels that day."[3] At Preston Pans in the same year, when Lochiel led the Camerons and Stuarts straight on the guns, "the countrymen whose horses had been seized to bring them into position ran away."[4] Seven guns were lost at Falkirk the following year. "At the beginning of the engagement," says the 'Gazette Extraordinary' of the 23rd Jan. 1746, "the horses of the Artillery ran away, and some of the dragoons in the left wing immediately gave way, as did some of the Infantry in the same wing."

[1] See his "Despatches;" i. 181; i. 425; ii. 89.
[2] Carlyle's "Hist. of Friedrich the Great;" iv. 118.
[3] 11th May 1745.
[4] Cust's "Annals of the Wars of the 18th Cent."

"Not one (of the guns) would have been lost," says General Wolfe, who was present, "if the drivers had not left their carriages and run off with the horses."[1] A respectable English publication of the day spoke in strong terms of the loss of these guns, and pointed out in the clearest words the true remedy against the recurrence of such scandals:—the drivers, said the "Annual Register," ought to be "enlisted under the military oath."[2] In India, where the ground is generally favourable for Artillery, field guns were as ill able to keep pace with Infantry as in Europe. In a battle fought between the French and the English near Trichinopoly in 1753, "the English, for more expedition, marched without any field pieces;" and when our Infantry marched against the French in an action fought shortly afterwards, "the Artillery in the hurry could not keep up with the battalions."[3] At Zorndorf, 1758, the conduct of some Prussian drivers was so disgraceful that Frederic at once posted Cavalry officers to the Artillery teams to keep them in order.[4]

[1] Wright's "Life of General Wolfe."

[2] xvi. 28.

[3] "Hist. of the military transactions of the British Nation in Indostan;" i. 312, 368.

[4] Troschke's "Die Beziehungen, &c.;" p. 33.

The causes that produced the movement towards a mobile Field Artillery were in operation, as has been shown, throughout all Europe. But in Prussia these common causes were supplemented by four special causes which rendered the possession of such a force a matter of paramount necessity.

In the first place, on his accession to the throne Frederic found his Cavalry drilled to fire in line at the halt.[1] The pernicious consequences of this system were so evident at the battle of Molwitz that he abolished it without delay. The Cavalry being thus deprived of their fire, the necessity arose for a branch of Field Artillery that could manœuvre with that Arm. "La Cavalerie ne rend pas de feux et ne peut se battre qu'à l'arme blanche," said Napoleon. "C'est pour subvenir à ce besoin qu'on a créé l'Artillerie à cheval."[2]

Secondly, the Prussian Infantry had attained at this time a rapidity of manœuvre greater than that of any other Infantry. In no army, therefore, was the slowness of movement of Field Artillery so conspicuous; in no other army did

[1] Nolan's "Cavalry Tactics;" p. 30.
[2] In Montholon; iii. 261.

the guns clog the motion of the other troops to so great an extent.

Thirdly, Prussia became eventually involved in a great war. In the Silesian wars she fought for conquest, but there were moments in the Seven Years' War when she fought for existence.

Fourthly, when in the field against the Austrians, the King was opposed by an Artillery in every way superior to his own. The noble conduct of the Austrian gunners at Königgrätz, a century afterwards, proved them to be worthy successors of the famous gunners of the Seven Years' War.[1]

Frederic's first impulse, after his experiences at Molwitz, was to follow the example of Gustavus Adolphus and arm the Field Artillery with a very light gun. In August 1741, he wrote to Prince Leopold of Anhalt-Dessau, suggesting that 6 Prs. should be altogether suppressed and their places supplied by 3 Prs., which were easy of draught and could be fired quickly.[2] Prince Leopold's answer to the King was at once reasonable and

[1] "Wir haben während dieses ganzen Krieges," writes Frederic, "die österreichische Armee . . . von dieser furchtbaren Artillerie unterstützt gesehen. Die Flanken sind mit Kanonen gespickt wie besondere Citadellen. Jeder kleine Vorsprung des Terrains wird benutzt, um Geschütze aufzustellen." In Troschke; p. 34.

[2] Ibid. p. 22.

firm. The 3 Prs., he thought, might be doubled in number; but no train of Artillery, in his opinion, would be complete without 2 or 4 howitzers, six 12 Prs., and ten 6 Prs. The King's correspondence upon Artillery matters, which thus began with Prince Leopold, was not only continued with him, but gradually extended itself to other officers, and eventually a series of experiments was carried out. The final result was the tardy recognition in Prussia of the natural and rational principle of Gustavus Adolphus,—the separation of the *matériel* of Field from that of Garrison Artillery, and the organisation of the former into Brigades of 10 guns each, instead of the old system of huddling the guns together in three or four huge, unmanageable trains.[1] Upon the subject of the 6 Prs., the King gave way unwillingly, saying,—"Ihr wisst dass Ich vom 6-pfünder nicht's halte."

To enable the reorganised Artillery to move as freely as its weight permitted, it was necessary to establish a close connection between the guns and their ammunition and gunners. Limbers, without ammunition boxes, seem to have been invented in the 15th century; limber-boxes only came into

[1] Ibid. p. 24.

use in the middle of the 18th century. The French battalion-guns were furnished with small ammunition boxes on the gun-axletrees;[1] the Austrian field-guns carried one on the trail;[2] the Prussian Artillery were supplied with limber-boxes at the instance of Captain von Holtzmann shortly after the beginning of the Seven Years' War.[3] But how were the gunners to be carried?

There are but five known ways of carrying gunners into action with their guns:—

(1) On cars, or special vehicles made to convey them; (2) on the ammunition waggons; (3) on the off-horses of the teams; (4) on the gun-carriages and limbers; or, (5) on special detachments of horses.

About the middle of the 18th century, when reorganising their Field Artillery, the Austrians adopted the car system for their Light or Cavalry-Artillery; but it was found to be so faulty that in 1788 it was given up and the gun-carriage system adopted.[4] Notwithstanding this, the French introduced the cars (or *wursts*) in 1791; but they, too, were obliged to discard them after a very

[1] Emp. Napoléon III.'s "Etudes, &c.;" iv. 95.

[2] With 14 rounds for the gun and 6 for the howitzer, "Die Kriegsmacht Oesterreichs," Wien, 1871; p. 40.

[3] Troschke; p. 10.

[4] "Die Kriegs. Oester.;" p. 40.

short trial.[1] Undeterred by these facts, we introduced them during the invasion panic of 1803; and so strong was the feeling in their favour that they were supplied even to the Horse Artillery, although they were so heavy that one of their three ammunition boxes "was always ordered to remain empty."[2] I may explain that the main difference between the car and the waggon system was this:—the car was a 2 wheeled vehicle, originally intended for the transport of gunners, in which a certain supply of ammunition was stowed away; while the waggon was a 4 wheeled carriage specially constructed for the transport of ammunition, on which the greater part of the detachment were mounted. The trial of the cars in England ended, of course, as it had done in Austria and France;—the cars were abolished. The waggon system was specious in theory and delusive in practice: it involved bringing the waggons—moveable magazines—under fire. As this was a risk no one would wantonly run, the waggons were almost invariably left in rear on service, and the pace of movement of the Battery was consequently reduced to the

[1] Decker's "Gesch. d. Geschütz.;" p. 151.

[2] "Remarks on the Organisation, &c. of the Royal Artillery" (by Sir Augustus Frazer, K.C.B., R.H.A.), London, 1818; p. 54.

pace of men on foot,—a walk. "Few, if any, instances of mounting the men on the guns and carriages can be found to have occurred on service during the whole course of the (Peninsular) war," says Sir Augustus Frazer, "and many were the cases in which the guns were either not brought to the points where they were wanted, or arrived just after the moment of opportunity had escaped."[1] If the commander of a Battery, from whatever cause, ventured to move at a trot, the gunners were left behind, and no one could foresee the disasters that might ensue. On the day after Salamanca, this defect well-nigh caused a calamity that might have brought the war to an abrupt and disastrous end—the capture of Lord Wellington. "I happened," says Sir Robert Gardiner, "to be employed in advance with a 9 Pr. brigade, covered by the Light Infantry of the 1st Division. . . . We were far in advance of the main body of the army, and on approaching a steep ascent, I discerned the Duke of Wellington on the summit, waving on the guns. We put out with all haste, and reaching the height, the Duke pointed to a large body of French Cavalry at a distance of 500 yards, and

[1] "Remarks, &c.;" pp. 44, 57.

only separated from him by an easy ravine. The horses, from the steepness of the ascent, could not measure their power in draught to the slow pace of the gunners; the gunners could not hasten theirs to that of the horses. It was a critical moment, threatening the Duke's safety; for at the moment the guns reached the summit, the gunners were still labouring, breathless, only half-way up the ascent. The enemy, from some inexplicable reason, failed to charge or move until the guns opened fire."[1] Forty-two years afterwards, 2 English Field Battery guns, outstripping their gunners, reached a knoll above the river Alma, and were worked by officers of the Head-Quarter Staff until their gunners came up. The mobility of these guns was not a whit greater than that of the few guns which accompanied Sobieski and his Cavalry on the Sunday morning when he relieved Vienna, 12th September 1683. These guns, too, had outstripped their gunners, and, on their running short of ammunition, it was a French officer who "rammed home the last round shot," using for a wad "his gloves, his wig, and a packet of French newspapers."[2] Such was

[1] "Notes on the Organisation, &c. of the Artillery," 1856; p. 16.
[2] Lord Ellesmere's "Two Sieges of Vienna;" p. 142.

the system of the English Field Batteries until 1873; such is the system of the French at the present moment.[1] The third, or off-horse system was partially adopted by the Swedes in 1797;[2] was afterwards tried and apparently rejected by the Prussians and Sardinians;[3] and was adopted in its entirety by the Bengal Horse Artillery. This system was supposed to require fewer horses than the detachment system. But it appears that this supposition was ill-founded. "The Bengal Horse Artillery found it necessary to have for all their carriages double teams, which were fully harnessed and ridden by *syces*, when not in draught. These double teams, together with the spare horses, made up a greater number than were required in a troop of Horse Artillery on the detachment system. Where the economy did consist was in the number of Europeans in the gun's crew, as compared with the detachment system—a question of consideration to the Hon.

[1] "La Batterie allemande peut ainsi se présenter au combat sans caissons, ce qui est impossible à la Batterie française. . . . Nous ne pouvons nous passer de nos caissons un seul instant."—"Du Défaut de Mobilité de l'Artillerie Française," L. de N.; Paris, 1886; pp. 7, 9. See also Gen. H. Müller's "Entwick. d. Fd. Art.;" ii. 140.

[2] Strotha's "Die Kön. Preuss. Reitende Artillerie," Beilage xi.

[3] Taubert's "Use of Field Artillery," trans. by Maxwell; p. 43.

East India Company, owing to the difficulty of obtaining recruits in England."[1]

So much for the economy in horses. But the off-horse system is vitiated by a much more serious defect. It fails to recognise the elementary fact that a horse can draw far more than he can carry. If a horse has to move a weight from one place to another, the worst position in which the weight can be placed is upon his back. Yet this is exactly what the off-horse system does. A team of horses which has to move a gun and its carriage and its limber and its ammunition, is required to move its detachment of gunners also; and to effect this the off-horse system puts the gunners upon the horses' backs. Far superior to this is the 4th or gun-carriage system, by which the gunners are placed upon the gun-carriage and limber. There are various forms of this system. For example, on the reorganisation of the Austrian Cavalry-Artillery in 1778, the new Batteries consisted of six 6 Prs., drawn by 6 horses each, and one 7 Pr. Hr., drawn by four. The carriages differed only from those of the medium (or Field Battery) guns in having a longer trail, on which was constructed the ammunition-box before men-

[1] Journal R.U.S. Inst., March 1897; p. 241.

tioned with a saddle on its top; and astride of this saddle, one behind the other, rode 5 gunners. A sixth gunner rode the off-centre or off-wheel horse of the team. Better, because safer and simpler, was the plan adopted by the Prussian and Bengal Field Batteries, of placing 3 gunners on the limber-boxes and 2 on the gun-axletree seats. The gun-axletree seats of the English guns at the present moment are not so commodious as they might be, but the position is a far safer one than that on the limber-boxes. If a man fall off the axletree seats, he is simply left behind; if he fall off the limber-boxes, he will most likely be killed by the gun-wheels. Superior in every way to the fore-mentioned systems is the detachment system, in which the gunners are mounted on horseback. In fact, the only arguments against it are its expense, and the great number of horses which it entails. This was the system on which Frederic organised his light Field Battery on 21st April 1759,[1] when weary of the delays and differences of his advisers.

The Horse Artillery thus formed by the King was unfavourably received both at home and

[1] Gen. von Strotha's work; p. 577. The Battery consisted of six 6 Prs., with 3 Under-officers and 42 gunners. See "Proceedings R.A. Institution;" vii. 462–3.

abroad. So little was thought of it by foreigners that for 30 years the Prussian was the only Horse Artillery in Europe. In Prussia, its enemies were, strange to say, the Artillery officers themselves. "Die Officiere der Artillerie waren dagegen," says General von Kalkreuth.[1] This fact probably explains why the King refused to entrust the training of the new Battery to his officers. An English officer "saw him nearly every morning exercising this new corps himself and directing its manœuvres."[2]

The total want of appreciation of the greatest step made by the Field Artillery since the time of Gustavus Adolphus was characteristic of the state of the Artillery officers of the day. A German officer describes the majority of them as sunk in ignorance and bigotry, both in his own country and in England;[3] and in France matters were even worse, owing to the incapacity of two successive rulers of the Artillery, the Vallières, father and son.[4] Both these officers had done good service in the field: neither of

[1] "Hist. Biog. Nachrichten zur Gesch. der Brandenburgish-Preussischen Artillerie," Schöning, 2 Theil.

[2] "British Military Library;" i. 19.

[3] "Ueber reitende Art., &c." Monhaupt; pp. 6, 64.

[4] The articles upon the Vallières in the "Biog. Universelle" are misleading and untrustworthy.

them possessed the high qualities requisite for the chief of an Artillery. The father might have used the words of Dr. Diafoirus with perfect propriety and truth :—" ce qui me plaît en (mon fils), et en quoi il suit mon example, c'est qu'il s'attache aveuglement aux opinions de nos anciens, et que jamais il n'a voulu comprendre ni écouter les raisons et les expériences des prétendues découvertes de notre siècle." [1] The effect of their rule was of course disastrous. " La situation dans laquelle se trouve l'Artillerie est effrayante ; il est certain qu'il faut avoir du courage et de la fermeté pour oser en faire l'exposition." Such are the words in which M. Dubois described the state of affairs in an official document drawn up by order of the French War Minister in 1763 ;[2] the year in which Gribeauval returned from Germany, where he had commanded the Austrian Artillery in the field, and had studied the organisation of the Prussian Artillery in Berlin after the peace. At that time military appointments were settled at Court, and Louis XV. probably took Cæsar's view of the matter :—

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[1] "Le Malade Imaginaire ;" ii. 6.

[2] "Etudes, &c.," Emp. Napoleon III. ; iv. 103.

"Let me have men about me that are fat;
Sleek-headed men, and such as sleep o' nights:
Yond' Cassius has a lean and hungry look;
He thinks too much: such men are dangerous."[1]

The Artillery wanted some little thought just then, but it got none. Vallière *fils* was a courtier and a man of small intelligence: Gribeauval was not a courtier and was a genius. Vallière, therefore, had qualifications for office which Gribeauval could lay no claim to; and it was not until Vallière's death in 1776 that Gribeauval was called to the rescue of the Artillery.[2] The following Table, J., shows a few of his reforms.

TABLE J.

	Weight of 12-Pr. Gun.	Weight of 12-Pr. Carriage and Limber.	Total.	Weight of 8-Pr. Gun.	Weight of 8-Pr. Carriage and Limber.	Total.	Weight of 4-Pr. Gun.	Weight of 4-Pr. Carriage and Limber.	Total.
	Cwt.	Cwt.	Cwt.	Cwt.	Cwt.	Cwt.	Cwt.	Cwt.	Cwt.
Vallière's system	28.5	15.7	44.2	18.8	13.2	32.0	10.2	11.5	21.7
Gribeauval's system	16.0	17.4	33.4	10.7	15.4	26.1	5.3	10.8	16.1
Difference	12.5	−1.7	10.8	8.1	−2.2	5.9	4.9	0.7	5.6
Gain per cent.	...	...	24.4	...	...	18.3	...	...	25.5

[1] "Julius Cæsar;" i. 2.

[2] Gribeauval was in office in 1765 for a short time,—too short to effect any reform.

These figures tell an unvarnished tale. The gain was net gain, for the guns shot just as well as Vallière's. Yet his followers affected to be dissatisfied,[1] and one of them asks:—"Etait ce la peine de faire tant de dépense et tant de bruit, pour perdre d'un côté et gagner si peu de l'autre."[2]

Judged by his work, taken as a whole, Gribeauval was the greatest reformer, certainly in the *matériel*, probably in the *personnel*, the Artillery world has ever seen. But his system, needless to say, was not perfect. His carriages were too heavy, his gunners were on foot; not a shot could be fired on coming into action until the guns had been shifted from the travelling to the firing trunnion holes; and holding fast by the old notion that guns should be moved by men under fire, he laid much stress on the man-harness he constructed for that purpose. Finally, thwarted by an irrational faction, he was unable to force into the French service the two great inventions of the century,—limber-boxes and Horse Artillery.[3] That he was perfectly aware of the

[1] Scharnhorst's "Handbuch der Artillerie," ii. 588, from which the above Table is taken.

[2] "Lettre d'un Officier du Corps Royal de l'Artillerie au Lieut.-Colonel du Régiment D.," Paris, 1774; p. 34.

[3] "Les améliorations les plus incontestables furent combattues avec un déplorable acharnement, par les nombreux partisans de

merits of the latter is evident from his words to M. de Vregille, when this officer proposed to him the organisation of some Batteries of Horse Artillery in 1762. "Vous voyez," said Gribeauval, "la peine que j'ai à detruire d'anciens préjugés, et les ennemis que m'ont suscités les changements que j'ai opéré; un jour nous exécuterons votre projet, preparez-le; pour le present ce serait trop vouloir."[1] It was too much to hope for *then;* but an event was at hand which stifled faction and paralysed intrigue. The French Revolution broke out; the arguments that had been used by Gribeauval (now in his grave) became instantly intelligible to men who had just declared them to be incomprehensible; and the merits of a light Field Artillery manifested themselves with marvellous clearness to those who had previously failed to perceive them. Fear accomplished what reason had failed to do, and Horse Artillery was formed in France. England,[2] Spain and other countries introduced

l'ancienne routine," says Cap. Mazé in the introduction of his "L'Etat actuel de l'Artillerie de campagne anglaise," p. viii.,—a translation of Jacobi's German work.

[1] Gassendi's "Aide-Mémoire de l'Officier d'Artillerie."

[2] For the recommendations of the Committee assembled to consider and report upon the formation of Horse Artillery in England, see "Proceed. R.A. Institution;" vii. 471–6.

Horse Artillery about the same time, Austria retaining her Cavalry-Batteries.

"L'engouement pour les bonnes choses conduit toujours à mal," says General Foy. "L'Artillerie à pied, énervée par la formation et l'augmentation de l'Artillerie à cheval, commença à perdre l'esprit militaire."[1] "La grande extension donnée à l'Artillerie à cheval nuit à l'Artillerie à pied," adds Colonel Favé. "L'histoire de l'Artillerie doit relater et étudier avec soin de pareils faits, et cette arme doit s'efforcer d'éviter à l'avenir les mêmes inconvénients."[2] To ascertain whether this deterioration of the French Field Batteries was due to local or general causes, we must take a glance at the state of the Field Batteries elsewhere.

In 1793 the gun-carriages and ammunition-waggons of our Field Batteries in Flanders were "of a very faulty construction, and the drivers were either hired men, or men borrowed from the Infantry. . . . The carriages were of single draught, and the drivers were in consequence on foot, having generally 3 horses to 1 driver. . . . At this time, however, the British Artillery had

[1] "Hist. de la guerre dans la Péninsule, &c.;" i. 119.
[2] "Hist. et Tact. des Armes;" p. 216.

the mortification of seeing the English waggons which were furnished to the Hanoverian Artillery drawn by four horses and driven by two drivers mounted. During the campaign of 1793 many necessary improvements were suggested and reported to the department at home; but their adoption having been refused, the Artillery took the field in 1794 little otherwise benefited by the preceding campaign than by the knowledge of its own defects. . . . Although the remedies to these defects were simple and obvious, yet we find even in the home encampment near Swinley, in the year 1800, the system was not abandoned. . . . By this time the superior efficiency of the Horse Artillery, from having its officers, men and horses regularly appointed and constantly fixed to the same guns, became apparent; and the reflective part of the corps could not but hope that a system so obvious to reason and so demonstrably proved by practice, would be generally adopted in the Field (Batteries). . . . Yet nothing was done, and no brigades or organised bodies of Field Artillery were formed."[1] In 1798, as Quartermaster Tate relates, the Commandant of Woolwich

[1] "Remarks, &c.," by Sir Aug. Frazer, K.C.B., R.H.A. This officer commanded the R.H.A. during the last three years in the Peninsula, and at Waterloo.

inspected some guns manned by gunners of the 8th Battalion R.A. The guns were each drawn by 3 horses in single file, which were driven by contract drivers on foot, hired for the occasion, dressed in white smocks with blue collars and cuffs, and armed with long carters' whips. When this procession had been reviewed, the Garrison Adjutant remarked that Field Artillery movements could not be performed quicker; to which the Commandant assented.[1] Such Field Batteries were, in the words of Sir Robert Gardiner, "an incumbrance to the army, and often a source of embarrassment to its movements."[2]

This state of things did not escape the notice of foreign officers. "In spite of the want of a judicious and systematic organisation," says Scharnhorst in 1806, "the English Artillery has always been distinguished for its bravery. Their conduct at Minden gained for them the special thanks of Prince Ferdinand, and the successful defence of Gibraltar was entirely due to them. In the wars of the French Revolution no soldiers were before them in willingness and courage;

[1] "Aide-Memoire to the Military Sciences," art. 'Ordnance.'
[2] "Observations, &c. on the Royal Artillery;" p. 9.

but their frequent want of ammunition, the bad condition of their horses, &c., &c., show that their organisation is a faulty one."[1] Scharnhorst had need to look nearer home.

After the peace of Basle, 1795, the Prussian Field Batteries entered upon a glacial period of torpor resembling that through which the French Artillery passed before Gribeauval came into power. Officers were put in command of Batteries they had never seen before, and only 2 officers were attached to Batteries of 8 and 10 guns. The horses and drivers, both quite untrained, joined the Batteries only a few days before a march. The drivers were wretchedly clothed, and commanded by broken-down Cavalrymen (halbinvalide Kavaleristen), under the title of *Schirrmeister*. Little attention was paid to the harness, which was usually in the Collar-maker's hands after a few marches. The Wheelers and Shoeing-smiths were unskilled; no two wheels were matches; one gun would not fit the carriage of another, and frequently did not fit its own. The spare stores were of little use, as they bore but little resemblance to those they were intended to replace. Furthermore, while there was an

[1] "Handbuch der Artillerie;" ii. 607.

abundance of perfectly useless articles, the most necessary were wanting. Thus, between 1795 and 1807, the Prussian Field Batteries took the field, badly equipped, meanly horsed, manned by unskilled gunners, and deficient in numbers. This picture was drawn by no censorious foreigner, but by Major Carl von Decker of the Prussian General Staff.[1]

It is clear from the foregoing remarks upon the English and Prussian Field Batteries, that the deterioration of the French Field Batteries at this time was not owing to local influences. The Field Batteries were depressed everywhere by some general causes. What were these causes?

The first of these causes was undoubtedly the change in tactics brought about by the French Revolution. Gribeauval constructed his system with a view to enable his Batteries to act with troops moving at the pace of the Prussian Infantry.[2] But within three years after his death (1789) the old tactical system was swept away, and a new one forced upon the French. A

[1] "Geschichte des Geschützwesens, &c.," Berlin, 1822; p. 13 ff.

[2] "Le but que Gribeauval se proposait, c'était une mobilité assez grande pour pouvoir, dans toute espèce de terrain, suivre les mouvemens d'une Infanterie aussi mobile que l'était l'Infanterie prussienne."—Favé, "Hist. et Tact. des Trois Armes;" p. 148.

marked characteristic of the new tactics was the rapidity of movement conferred upon the Infantry. An Artillery, therefore, constructed with the express intention of supporting 'the processional movements' of the Prussian tactics, was plainly unequal to the requirements of the French Division, the tactics of which were at once "leste, élastique et osée."[1] To meet the want thus created came the Horse Artillery; the immense advantage of being able to move rapidly was shown practically in the field; the usual and natural reaction took place; the value of mobility was over-estimated; and those who a few years previously had set their faces against Horse Artillery, were now calling for Horse Artillery and Horse Artillery only.[2]

Time would have lessened and finally neutralised the ill effects of this cause upon the neglected Field Batteries; because fuller experience would have shown that in the Field Artillery, as in every other machine, what is gained in speed is lost in power. "The necessary quick movements of the Horse Artillery cannot be attained by 9 Prs.; the telling effect of 9 Prs. cannot

[1] Trochu's "L'Armée Française en 1867;" p. 254.

[2] "Bientôt les généraux ne voulurent plus avoir d'autre Artillerie."—Foy's "Hist. de la guerre de la Péninsule;" i. 119.

be expected from Horse Artillery."[1] But the mode in which the light Batteries were organised inflicted far more injury upon the medium than any change in tactics could have caused. The Horse Artillery was a *corps d'élite* in its most naked form. Such officers and men and horses and harness as were supposed to be the best were selected for this branch. It was forgotten that the strength of a chain is the strength of its weakest link; that the sure and invariable effect of such a course is "l'enervation de la masse au profit des groupes."[2] Among other consequences of this system, it may be mentioned that as the biggest men were taken for the Horse Artillery, the lightest guns went into action manned by the heaviest men, and the heaviest guns by the lightest men of the Field Artillery.

Thirdly, the Field Batteries were assumed universally to be a branch of the Garrison Artillery. The reasoning by which this conclusion was reached appears to have been as follows:— the Field Batteries must be connected with either the Horse Artillery or the Garrison Artillery. But they are not connected with the Horse Artil-

[1] "Report on the numerical deficiency, &c., of the Royal Artillery," by Sir R. Gardiner, K.C.B., R.H.A.; p. 25.

[2] Trochu's "Armée Française en 1867;" p. 203.

lery, because "the Horse Artillery are the Artillery of motion, the Field Batteries the Artillery of rest."[1] Therefore, &c., &c. The Artillery was accordingly divided into the Horse Artillery and the rest of the Artillery, not into the Artillery that accompanies an Army into the Field and the Artillery that does not,—Field Artillery and Garrison Artillery. It would have been as rational a proceeding to divide the population of England, not into males and females, but into curates and the rest of the inhabitants. This unnatural division led, of course, to a number of surprising results. For instance, an officer commanding a 9 Pr. Battery was considered quite unfit to command a 6 Pr. Battery unless he had previously served in one, while an officer who had spent the whole of his previous service with 10-inch shell guns and 13-inch mortars was thought perfectly capable of commanding a 9 Pr. Battery.

One of the first effects of the Revolutionary tactics was the suppression of the battalion guns, which Gribeauval had been forced to retain.[2] It

[1] "Das Element der Fussartillerie ist der Stand, das der reitenden die Bewegung."—"Ueber reitende Artillerie," Monhaupt; p. 13.

[2] "Le feu Général Gribeauval avait été forcé d'adopter les pièces

had been difficult enough to make use of these guns under the tactics of the Seven Years' War; it was absolutely impossible under the rapid Revolutionary tactics. In 1795 the French Battalion guns were reduced to one per Battalion, and this one was done away with immediately afterwards. This step rendered urgent the formation of a regular body of drivers. The contract drivers were in a wretched state :—"continuellement sans pain, sans solde, sans habits; et leurs chevaux sans fourrage, sans fers, et sans harnais."[1] In this state of things the First Consul directed General Lespinasse to report upon the formation of a regular corps of drivers and other matters affecting the organisation of the Field Artillery. The General did so, and warmly advocated the enlistment of the drivers. This proposal was, of course, opposed,—the dull, like the poor, we have with us always. To give military rank to waggoners, it was said, was to degrade the name of soldier,—"ravaler le soldat."[2] But the First Consul was deaf to such objections, and in 1800 was enrolled a large body of Artillery drivers.

de bataillon, parceque c'était la manie de son temps."—"Essai sur l'organisation de l'arme de l'Artillerie," Gen. Lespinasse, Paris 1800; p. 111.

[1] Lespinasse; p. 58. [2] Ibid.

We followed the example of the French in (I believe) 1802, when a Corps of Drivers was formed under their own officers. Owing either to the class of men enlisted, or to some laxity in their discipline, the conduct of these drivers was a constant source of trouble to every one connected with them. To them Capt. Adam Wall, who commanded the present 9th Field Battery, attributes most of the disorders that occurred during the retreat to Coruña. "I am convinced," he says, "that the irregularities spoken of by Sir John Moore were committed by the drivers of the different brigades; at least I can declare that my drivers contributed in a great measure, and I cannot help wishing that this scourge of the army was no more."[1] They were disbanded in 1817. Of the conduct of our gunners during the six years' struggle in the Peninsula, the enemy is the best judge. "Les canonniers," says General Foy, "se distinguent entre les autres soldats par le bon esprit qui les animes. En bataille, leur activité est judicieux, leur coup-d'œil est parfait, et leur bravoure stoïque."[2]

During the early years of the century, we made

[1] "Diary of Operations under Sir J. Moore," in "Proceed. R.A. Inst.;" xiv. 334.

[2] "Hist. de la Guerre de la Péninsule, &c.;" i. 294.

four signal improvements in the *matériel* of Field Artillery. By equalising the size of the limber and gun-wheels, we diminished the draught and made all our wheels interchangeable. We established a strong, practical and simple connection between the gun and limber by devising the present pin-tail and trail-plate-eye. By the introduction of the block-trail we diminished the weight of the clumsy bracket-trail, and enabled the carriage to reverse in a shorter space. Finally, Lieut.-Col. Henry Shrapnel, R.A., invented a projectile which he called 'Spherical Case.' Bearing his own name now, it is the chief projectile for rifled guns, and its capabilities are by no means exhausted.

General Foy, who saw the English Artillery after the Convention of Cintra, 1808, declares that no Artillery could compare with the English in the lightness of the carriages and in everything connected with the means of draught.[1] Marshal Marmont, an Artillery officer, on inspecting a Troop of the Royal Horse Artillery shortly before Waterloo, said that "the equipment in every respect was very far superior to anything he had ever seen."[2] In 1815, after the occupation

[1] "Hist. de la Guerre de la Péninsule;" ii. 296.

[2] "Letters of Sir A. Frazer, R.H.A., during the Peninsular and Waterloo Campaigns;" p. 502.

of Paris by the Allies, Captain Parrizot of the French Artillery, in a memoir upon the English Artillery, pronounced it to be superior to all others in the following respects:—1st, interchangeability of *matériel;* 2ndly, ease of limbering-up and unlimbering; 3rdly, construction of the wheels; 4thly, the transport of the gunners; and 5thly, the system of draught. Finally, the French Government appointed a Committee of Artillery officers to report on the different allied Artilleries that took part in the grand review of the 18th October 1818. After noticing the peculiarities of the various systems—the English guns with 8 horses; the Russian waggons with 3 horses abreast; the Danish heavy field-pieces with 12 gunners a gun; the Saxon Batteries with a gunner on the off-leaders of the gun and waggon, 2 gunners on a trail-seat, and 2 on the waggon-limber—the Committee unhesitatingly gave the palm to the English batteries. They were particularly delighted with the manœuvres of one Field Battery over very difficult ground, and they generously confessed that no French Battery could have cleared the ground like the English. "By mounting the gunners on the gun-limber and waggon," said the Committee, "by ridding them of their cum-

brous and useless carbines, and by attaching the knapsacks to the carriages . . . the English have made the Field Batteries a new arm." [1]

With peace came reduction, and in England we rushed to the demolition of our military establishments as if Satan had been bound for 1000 years and there was to be no more war. The Field Batteries were disbanded; the troops of Horse Artillery were reduced to 2 guns each; and in 1848 an Artillery officer announced to an astonished public that there was not "a single 9 Pr. horsed in the English service. . . . If any sudden emergency rendered it necessary to send Field Artillery from Woolwich to any threatened point on the coast, *fourteen guns* would be the utmost (really efficient and completely equipped) that could be forwarded." [2] But for the exertions of Sir Robert Gardiner, Lord Hardinge and H.R.H. the Duke of Cambridge, we must have improvised Field Batteries for the Crimean War.

[1] Favé, in "Le Passé et l'Avenir de l'Artillerie;" pp. 72, 76, 78, 84.

"Das System war solide, zweckmässig und vornehmlich sehr beweglich, so dass es gleichsam als ein Muster betrachtet, von vielen fremden Artilleristen begehrt und von meheren Artillerien auch mit geringen Aenderungen angenommen wurde."—"Die Entwickelung der Feld-artillerie," Lieut.-General H. Müller, Berlin, 1893; i. 9.

[2] "Report on the numerical deficiency, &c. of the Royal Artillery," Sir R. Gardiner, 1848; pp. 7, 16, 17.

While the English Artillery suffered far more than their continental brethren from the effect of reduction, the English army in all its branches was depressed by a special influence which naturally enough arose during the long peace, as it had previously arisen during all long periods of peace, — the influence of the Royal Navy.

For an insular power like England, the heart of a great Empire, a large and powerful fleet is an absolute necessity. If she aims an offensive blow against the enemy, the transports in which her soldiers embark must sail under the protection of a strong squadron. If, on the other hand, an enemy meditates an invasion of her shores, the fleet becomes of greater importance than ever; for the grand object naturally is, not to defeat him after he has landed, but to prevent him from effecting a landing. Further, the Navy has to maintain the communications between her Colonies and foreign possessions, and to keep open the lines of food-supply upon which (unfortunately) this country is so dependent. In fact, from whatever point of view the matter be regarded, the Navy occupies the first and highest position among the war-forces of an insular

nation; and the only criticism that can be made upon the recent augmentations of our Navy is, that they were not great enough, either in men or in ships. It is easy to understand the influence which the Navy exerts upon the Army in England, or in any insular country. The more the money and attention lavished upon the Navy, the less, in general, the attention and money spent upon the Army. Except in time of actual war, the more efficient the fleet, the safer men will consider their lives, their freedom, and their property; and if peace last long enough, enthusiasts will not be wanting to proclaim that the Army is an unnecessary evil.

A mere glance at our military history is sufficient to show that the mischievous (although quite involuntary) pressure of the Navy upon the Army is no mere fancy, but a well-founded fact. From the invention of gunpowder to the conclusion of our continental wars in 1559, the English army was almost constantly engaged abroad, and it was consequently equal, in all its branches, to any army in Europe. The Navy had been improved and strengthened during these wars; on their close the country was safe from invasion; and from that time the Army was

neglected in all its branches until the accession of William III. The English Artillery employed in the civil wars of Charles I. was probably the worst in Europe. During the reigns of William III. and Anne, active service again increased the efficiency of the Army; but on the conclusion of Marlborough's wars, the Army returned home to languish in the cold shade cast upon it by our splendid Navy until the outbreak of the French Revolution. It is true that in the interim the Army was engaged in the Seven Years' and American wars; but the number of troops engaged was too small, and the time they were on service was too short, to counteract to any appreciable extent the influence of the Navy. On the outburst of the French Revolution, however, it was necessary to bring not only the Navy but the Army to the highest degree of efficiency, because it was necessary to take the field in force; and the Army was thus completely relieved from the pressure of the Navy from 1792 until 1815. When the general peace was concluded, the Army again fell under the shade of the Navy.[1]

We must now turn our attention to the pro-

[1] The only writer I am acquainted with who dwells upon this matter is Brunet, "Hist. générale de l'Art., &c. Militaires;" Paris, 1842; ii. 118.

gress of the *matériel.* The advances of Metallurgy, the inventions of the Mechanical Arts, produced considerable improvements in the construction of ordnance during the first half of the present century; but no very striking results were achieved until the introduction of rifled guns, some twenty years after Nasmyth's great invention of the steam-hammer.

The introduction of rifled guns marks the most critical moment in the whole history of Field Artillery, and it was a happy accident for this service that the rifled gun came before, not after the breech-loading rifle. Had the breech-loading rifle come first, and had the manufacture of rifled guns been delayed many years, fortresses and ships might have retained their smooth-bore guns in undiminished numbers, but the Field Artillery would have shrunk before the breech-loading rifle to a fraction of its former size, and might conceivably have disappeared altogether.

The range and accuracy of the rifled guns far surpassed those of the smooth bores; the increase of range being due to the fact that elongated (rifled) projectiles lose their velocity much more slowly than round shot. This is shown in the following Table:—

TABLE K.

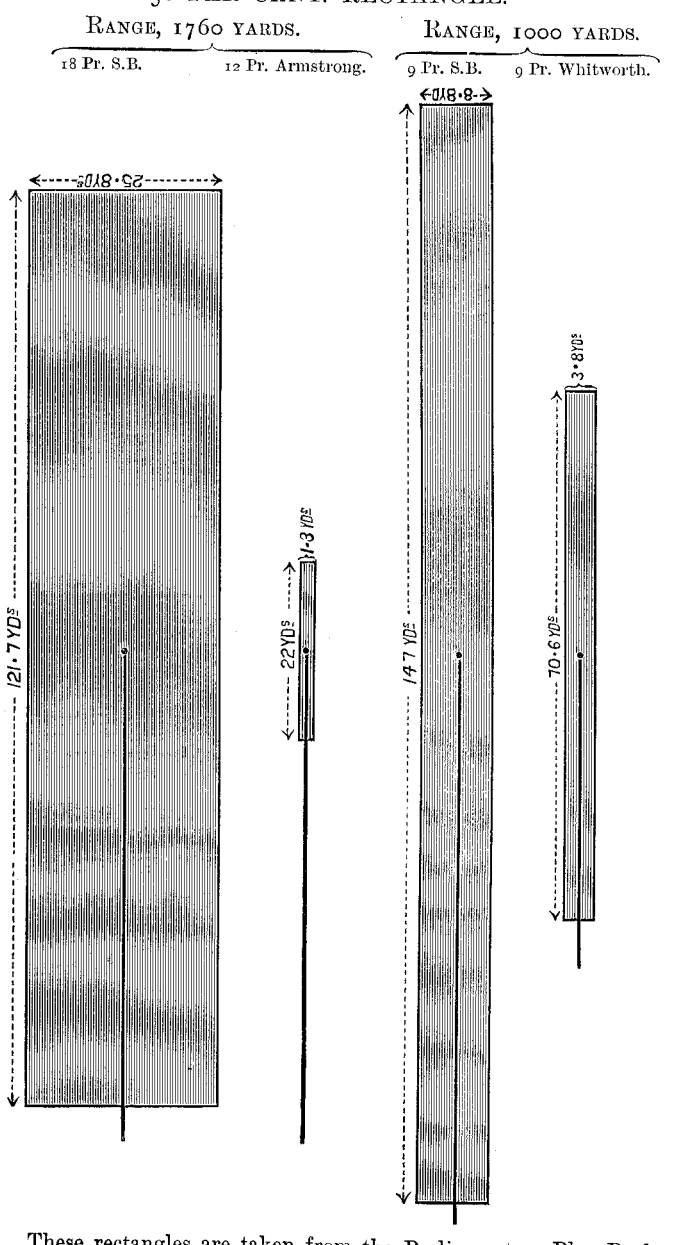
Guns.	Velocity		Loss per Cent.
	at Muzzle	at 30 yards.	
	F.s.	F.s.	
6 Pr. Armstrong .	946.4	937.5	0.9
6 Pr. S. B. . .	1484.5	1435.3	3.3

TABLE L.

Guns.	Energy at		Loss per Cent.
	1000 yards.	2000 yards.	
	Ft. Tons.	Ft. Tons.	
7″ Woolwich Gun .	1042	814	21.8
68 Pr. S. B. . .	298	136	54.3

The increase in accuracy is shown by the following 50 per cent. rectangles, *i.e.* the rectangles into which it is even betting one-half the shot would fall if a large number of rounds were fired.

50 PER CENT. RECTANGLE.



These rectangles are taken from the Parliamentary Blue Book, "Report: Ordnance," 25th July 1862; p. 167.

No signal advance was made in the manufacture of gunpowder, or in a knowledge of its properties, from the time of Robins until 1815, when Sir William Congreve revolutionised its manufacture. As years passed by the chemists devoted their attention to the subject. The temperature, volume and nature of the gases evolved on explosion, &c., &c., were investigated; but it was not until Electricity came to the help of Gunnery that the effect of the size and shape of the grains upon the pressure within the bore, and the muzzle-velocity of the projectile, became exactly known. In 1840 Professor Wheatstone proposed an Electro-magnetic Chronoscope, but the matter fell through. A few years afterwards, 1848, Captain Navez of the Belgian Artillery brought forward his Electro-ballistic Pendulum, which in time was followed by several others, among which may be mentioned Professor Bashforth's Chronograph. By means of these instruments and Pressure Gauges of various patterns, the varying pressure upon the bore of the gun and the muzzle-velocity of the projectile became accurately known; and the consequence was the manufacture of the powders known as pellet,

pebble, prismatic, &c. The following Table, M., shows some of the results :[1]—

TABLE M.

Diameter of Grains.	Charge.	Weight of Shot.	Muzzle-Velocity.	Pressure on Bottom of Bore.
Ins.	Lbs.	Lbs.	F.s.	Tons per Sq. In.
0.1	8	43	1261	21.5
0.15	8	43	1235	21.0
0.2	8	43	1199	18.8
0.25	8	43	1151	17.1
0.3	8	43	1146	15.3
0.4	8	43	1187	14.2

Meanwhile the mathematicians were not idle. The merits of a uniform and varying twist in the rifling were discussed; Professor Bashforth devised a method by which a close approximation to the actual shape of the trajectory may be obtained; Professor Greenhill found the *minimum* twist that must be given to a projectile of given length to ensure its stability of rotation, *i.e.* to prevent it from wobbling or turning over in its flight,—a remarkable investigation, because a property of

[1] Romocki's "Gesch. d. Explosivstoffe;" ii. 20.

matter is deduced from purely mathematical considerations.

It was known that the chemists, and foremost among them Sir F. Abel, had been for years experimenting with explosives; but it was generally supposed that however useful such experiments might prove for industrial objects, gunpowder would long retain its position as the best explosive for weapons of war. In 1886 Professor Hebler wrote:—"es liegt daher auf der Hand, dass das schwarze Pulver noch nicht in Gefahr ist, in Bälde verdrängt zu werden."[1] Scarcely had the words been set up in type when M. Vieille supplied the French Government with a nitrocellulose explosive which gave a higher muzzle-velocity, with less pressure, than ordinary gunpowder; and in the course of a few years every Infantry and Artillery in Europe was supplied with explosives of the nitrocellulose family. The following Table, N., gives some of the qualities of various forms of gunpowder and cordite:—

[1] Romocki's "Gesch. d. Explosivstoffe;" ii. 267.

TABLE N.

Powders.	Charge.	Muzzle-Velocity.	Maximum Pressure on Bore.
	Lbs.	F.s.	Tons per Sq. In.
Large Grain (R.L.G.)	30.0	1324	29.8
Russian Prismatic .	32.0	1366	20.5
Service Pellet . .	30.0	1338	17.4
Pebble, No. 5 . .	35.0	1374	15.4
Cordite . . .	32.6	2150	13.8

The next Table, O., gives the comparative qualities of Nobel's powder, the French powder and cordite, calculated by a formula deduced by Mr. Longridge, under the following conditions:[1]—

Weight of Powder, ...	19.5 Lbs.
Weight of Projectile, ...	100.0 „
Travel of Projectile, ...	216.9 Ins.
Calibre, ...	6.06 „
Equivalent Length of Chamber, . .	37.9 „

[1] Longridge's "Artillery of the Future," 1891 ; p. 37.

TABLE O.

Powders.	Maximum Pressure on Projectile.	Muzzle-Velocity.	Energy of Projectile.
	Tons per Sq. In.	F.s.	Ft. Tons.
B.N. (French)	9.02	2068	2965
Nobel . .	12.99	2433	4105
Cordite . .	26.10	2677	4967

To describe the successive guns with which the different Powers supplied their Artilleries before they reached their present armaments, would require a special volume, and would afford little real information. The different armaments were a series of experiments. Two matters only call for notice,—the French and English adoption of muzzle-loaders, and the position of the machine-gun.

When adopting rifled guns, the French chose the muzzle-loading system and retained it until 1871. We in England began with a breech-loader, but we recanted in 1866; went back to the muzzle-loader, and retained it until 1886. We have only just shaken off the effects of these 20 years of retrogression. Several explanations

have been offered of these strange facts, but they are explanations in which nothing is explained. The real explanation may not become known for another generation.

With regard to machine-guns, it is beyond question that these guns are useful and necessary to Infantry and Cavalry on occasion; but is there any sufficient reason for attaching them permanently to either of the two services? No more reason than for attaching permanently to the Artillery the Infantry and Cavalry escorts which the Batteries occasionally require. It is mere playing with words to take machine-guns for anything but pieces of Artillery,—delicate and complicated pieces of Artillery too. Their distribution to the Infantry is merely a revival of the system of Battalion guns, whose defects have been considered at length on a previous page. Their distribution to the Cavalry is even more injurious. Troopers have already two distinct and necessary sets of duties to perform:—their work mounted, as Cavalry proper; and their dismounted, or Infantry work. It is difficult to see by what arguments a serious addition to these multifarious duties can be supported. One thing is sure: while the troopers

are working their machine-guns, they are employed neither as Cavalry, nor as Infantry, but as Artillery. "Simplicity is necessary in war," said Clausewitz, "but simplicity is difficult." It certainly does not conduce to simplicity to provide a Cavalry Brigade with two separate Artilleries,—their machine-guns and their Horse Artillery. And this is not a case in which simplicity is difficult. All that has to be done is to attach the machine-guns to their natural owners, the Horse Artillery,[1] and thus supply the Brigade with one Artillery, not two Artilleries.

The introduction of breech-loading rifles produced no considerable change in the tactical use of Field Batteries: it produced a marked effect upon the Horse Artillery. When the Prussian War Minister signed the first order for breech-loading rifles, he abolished the 'case tactics' of the Horse Artillery by a stroke of his pen. The brilliant Horse Artillery tactics of the French Revolutionary period became a thing of the past. To gallop up to 350 yds. range and batter a bewildered Battalion in close formation before it could deploy, was a safe and effective mode of attack against Infantry armed with muskets whose extreme effec-

[1] In addition to their own guns.

tive range was 200 yds.; but to attempt such tactics against Infantry armed with breech-loaders was to rush upon certain destruction. Therefore the Horse Artillery is useless, it has been concluded by hasty reasoners. This is an unwarrantable conclusion. The 'case tactics' of the Horse Artillery have gone the way of other tactics; but the value of this branch of Field Artillery in combination with Cavalry, in pursuits and retreats, in advance and rear-guards, in sudden expeditions,—in fact, on every occasion where mobility is the great *desideratum*, is as high as it ever was. The logical conclusion from the facts is, not that Horse Artillery is useless, but that the portion of the Horse Artillery which used to be specially reserved for the 'case tactics' is no longer required. In other words, the proportion of the Horse Artillery to the Field Batteries is smaller than it was in the days of the French Revolution.

At the present moment the road along which Field Artillery is moving seems to fork into two branches, the one leading to quick-firing guns, the other to the systems of Generals Wille and Rohne.

The essence of a quick-firing gun consists in absorbing (by whatever means) the recoil so com-

pletely, that the gun can be reloaded and fired again *without relaying it.* In no (land service) quick-firing system, so far as I am aware, has the recoil been so perfectly neutralised that relaying can be entirely dispensed with. All the guns I have seen or heard of require *some* amount of relaying,—the recoil is only partially absorbed; and the guns are really, as Major Mariani observes, "not quick-firing, but quick-loading guns."[1] Whether a quick-firing system will eventually be invented in which the recoil is completely absorbed, is not a question that concerns us here. When such a system comes, it will be quite soon enough to consider its merits with due attention. And it will merit much attention, for it may conceivably add much to the efficiency of Horse Artillery. The mechanical complications involved in (even partially) absorbing the recoil, together with the rareness of the occasions on which very rapid Artillery fire is required in the field, are sufficient to justify us in refusing to adopt any existing system.

Of the ability shown in General Wille's book[2]

[1] "Tolta la condizione dell' assoluta immobilità, il cannone cessa di essere a tiro rapido per assumere il carattere di cannone a carica rapida."—"La Questione dei Cannone da Campo dell' Avvenire;" p. 16.

[2] "Die Kommenden Feldgeschütze," Berlin, 1893.

there cannot be two opinions, and to him belongs the credit of being the first to endeavour to utilise to the fullest extent the qualities of the new explosives. But it is impossible to agree with some of his leading principles. He demands a range of some 8300 yds. for his Shrapnel and 11,000 yds. for his common shell. To attain these ranges he requires a muzzle-velocity of over 2600 feet a sec., and this entails a pressure on the bore of some 30 tons per sq. in., with its shattering effect on the carriage. Mr. Longridge thinks guns and carriages may be constructed to endure such strains;[1] but for how many rounds? A carriage has a life as well as a gun, and both would be short-lived under such extremely trying conditions. Further, the ranges for which these sacrifices are to be made are chimerical. We have not reached the period when battles will be lost and won at telescopic ranges.

On turning to General Rohne's book[2] we meet clear and simple mathematical demonstrations, and an arrangement of matter that leaves nothing

[1] Quoted in Müller's "Entwickelung der Feldartillerie;" ii. 401.

[2] "Studie über den Schrapnelschuss der Feld-Artillerie," Berlin, 1894, which has been translated by Col. Walford, R.A.

to be desired. Indeed it would be hard to find, in any language, a more lucid and masterly treatment of a difficult subject. But this fair structure is built upon the sands. General Rohne deduces his whole system from the assumption that a Shrapnel shell ought to burst in a certain arbitrary way at a certain arbitrary range. This basis is fictitious. However efficient a projectile Shrapnel may be, it is an accident, not an essential, of any system of Field Artillery. No longer ago than 1870, General Rohne's own corps, the Prussian Artillery, went successfully through a long and arduous campaign without any Shrapnel at all. But whether field-guns fire the stone balls of the Middle Ages, or the case of the leather guns, or the Shrapnel of General Rohne's, they must be able to move at a certain pace. Motion in fact is, what Shrapnel is not,—an essential of every possible system of Field Artillery. The basis of any system, in a word, is the *maximum* weight which the teams can draw at the pace at which the system will be required to move; and upon this, and no other basis, can a system of Field Artillery be founded with certitude and safety.[1]

[1] This principle was stated in the "Proceed. R.A. Inst.," vii. 458–9, more than 20 years ago. Major Mariani, who seems to have arrived at it independently, puts it in very slightly different words:

What is the greatest number of horses that can work together effectively at the three paces (available for draught) which the horse possesses —the walk, the trot and the gallop? On such matters as this there will always be some small diversity of opinion; but the majority will agree that 12 horses, 4 abreast, are the greatest number that can draw together effectively at a walk; 8 horses, 2 abreast, at a trot; and 6 horses, 2 abreast, at a gallop.

What is the *maximum* load that 12 horses, 4 abreast, can draw effectively at a walk; 8, or 6 horses, 2 abreast, at a trot; and 6 horses, 2 abreast, at a gallop? The answer to the first question is, in round numbers, about 80 cwt.; to the second, 51 cwt. for 8 horses and 40 cwt. for 6 horses; to the third, 30 cwt.

We need proceed no further. Taking the medium gun for illustration, the problem for the gunsmiths is to construct the best gun they can, subject to the rigid condition that the weight of the system shall not exceed (for 6 horses) 40 cwt.,

—"parmi dunque che il modo piu adatto di procedere negli studi dovrebbe essere il seguente: Fissare il grado di mobilita di cui vogliamo che sia dotato il nostro materiale, e in base al peso che ne conseguira domandare alla metallurgia la bocca da fuoco piu potente e alla meccanica i mezzi di renderne piu celere il tiro."—"La Questione dei Cannoni da Campo dell' Avvenire;" p. 17.

—the 'system' including the gun, carriage and limber; at least 40 rounds of ammunition complete; the necessary gun stores; and 5 mounted gunners, 3 upon the limber and 2 upon the gun-axletree-seats.

The usual method of calculating the weight drawn by each horse of an Artillery team, namely, dividing the total weight behind the team by the number of horses, is incorrect; because it assumes that each pair of horses exerts the same amount of *effective* traction, and this assumption is not true in fact. There is some loss of draught for every additional pair of horses put in front of the wheelers, that is, the effective draught of the centres is somewhat less than that of the wheelers; the effective draught of the lead is somewhat less than that of the centres; and so on. This was proved by experiments in Sweden and France,[1] in which the loss was found to be about 6 per cent. for each additional pair of horses. Taking this

[1] See the trans. of an article on "The Means of Sparing Draught Animals," by Lieut. G. Frumerie, Swedish Artillery, "Artilleri-Tidskrift," No. 3 of 1884, in the "Proceed. R.A. Inst.," xiii. A series of experiments (with the aid of a good dynamometer) is required to clear up the whole question. Apparently 17 pairs of horses is the greatest number that can be used with any useful effect, an 18th pair adding nothing whatever to the effective draught.

fact into consideration, and supposing that each pair of horses exerts the same *actual* traction, the weights drawn by the different pairs would be approximately :—

GUNS OF POSITION.

4 wheelers	28.37 cwt.
4 centres	26.66 ,,
4 leaders	25.00 ,,
Total . . .	80.03 ,,

FIELD BATTERIES.

8 *horses.*		6 *horses.*	
2 wheelers .	14.00 cwt.	2 wheelers .	14.00 cwt.
2 wheel centres .	13.16 ,,	2 centres . .	13.16 ,,
2 lead centres .	12.32 ,,	2 leaders . .	12.32 ,,
2 leaders . .	11.48 ,,	Total .	39.48 ,,
Total .	50.96 ,,		

HORSE ARTILLERY.

2 wheelers	10.64 cwt.
2 centres	10.00 ,,
2 leaders	9.36 ,,
Total . . .	30.00 ,,

Such are the greatest weights that can be put behind the respective teams without running

the risk of foundering the horses in a long series of marches. But there is another matter to be considered. Apart from the great loss in horses that inevitably takes place during a campaign, from hardship and starvation, the loss of horses in action is greater than that of men, the ratio in modern battles being about 112 to 100. Further, whereas a Cavalry charger killed means simply one horse killed, each draught horse killed diminishes an Artillery team by two horses, owing to the mode of draught. After a few hours under fire, therefore, four horses, or perhaps two, may have to attempt to do the work of six, if the Battery be ordered to move. The conclusion is that to overweight the teams at the outset, or even to burden them with the weight which just admits of their working at the required paces in time of peace, is to ensure absolute inefficiency in time of war.

It seems to me that two fallacies lurk under the apparently innocent phrase used by Generals Wille and Rohne, Mr. Longridge and others,—"the Field Gun of the Future." In the first place, it assumes that in the future there will be only one Field Artillery system, instead of two as at present,—the Horse Artillery and the Field

Batteries. Without pretending to a knowledge of the secrets of the future, it may be said that as long as the Infantry and Cavalry remain what they are we shall require two systems of Field Artillery, for the same reason that we require two shoes. We require two shoes because we have two feet. We have two bodies of troops, Infantry and Cavalry, with different rates of motion, which both require more or less the support of Artillery. Therefore we require two systems of field-guns, with different rates of movement. In the second place, the phrase 'gun of the future' seems to assume that we have reached a resting-place in the construction of Artillery, owing to some pause, some break in the succession of discoveries and inventions. "Incurable paresse de l'esprit humain," exclaims Guizot, "qui veut toujours se croire au terme et s'y reposer!" The pause is purely imaginary: we live in a state of ceaseless change. Of what avail is it to peer into the future and to presume to foretell its wants, when a new discovery in explosives, in alloys, in the handling of metals, or even in electricity, may produce in a moment the most astonishing and unexpected changes in the *matériel* of Artillery? We can neither control nor foresee the course of the Arts and Sciences:

all that we can do is to make the most, for the moment, of the little knowledge we possess. Let us, then, content ourselves modestly with improving the gun, the carriage, and the ammunition of the Present, and leave the Future to shift for itself.

IV

THE RECONNOITERING DUTIES OF CAVALRY

"In all armies," says Sir James Turner, Knt., Adjutant-General of the Scottish Army towards the close of the 17th century, "in all armies Intelligence is the life of action, but how to get good intelligence is an art yet to be found out; and I say more, it will never be found out so long as it remains true that all men are lyars; for so long as men are so, what intelligence shall men believe? We are not to expect it from Angels, and the Devil was a lyar from the beginning. To confirm this by one instance which is unquestionable: what intelligence durst the leader of God's people trust, when 10 out of 12 intelligencers, which by God's appointment were sent to spie out the Land of Promise, did by their fearful and false relations make the people murmur?"[1] The prediction of the Adjutant-General has not been fulfilled. Notwithstanding the infirmity of human nature, the commander

[1] "Pallas Armata," London, 1683; p. 260.

of an army now receives very valuable information from his Cavalry, if well led and well instructed.

We have been frequently told that reconnoitering Cavalry are 'the eyes and the ears of an army,' a phrase that leaves us no wiser than we were before. The practical questions are, where do they go, and what do they do? The best answer to these questions is an actual illustration from military history. Example is better than precept in a matter where so much depends upon the peculiar features of each case. The examples selected are the operations of the Cavalry Division which covered the advance of the Crown Prince of Prussia from Landau, by Wissembourg, Wörth, Saverne, &c. to Sedan, in 1870; and the intended operations of the same Division in the Loire campaign against General d'Aurelle de Paladines. The account of the Crown Prince's Cavalry is paraphrased from the Darmstadt "Allgemeine Militär-Zeitung" of the 16th, 23rd, and 30th August 1871.

OPERATIONS OF THE CROWN PRINCE'S RECONNOITERING CAVALRY.

On the 2nd August 1870, Prince Albrecht of Prussia took command of the 4th Cavalry Division at Landau.[1] The Division consisted of 3 Brigades: the Heavy Brigade commanded by Major-General von Hontheim; the Uhlan Brigade commanded by Major-General von Bernhardi; and the Light Brigade commanded by Major-General von Krosigk; and 2 Batteries of Horse Artillery.

The Division was present at the combat of Wissembourg on the 4th August, and received orders to follow up the enemy. At daybreak on the 5th they began the pursuit and advanced across the Souly, in the neighbourhood of Hagenau. During the day, however, they learned from prisoners that the main body of the French was retreating on Wörth. They bivouacked at Hundsbach on the night of the 5th, and at 5 P.M. on the 6th got orders to pursue MacMahon closely. They marched at midnight,

[1] See Map 1. The reader will not expect strict accuracy of detail as regards the advanced parties in either of the Maps given. Such details could be only shown upon Maps on a much larger scale. The object of the two Maps is merely to give a general notion of the relative positions of the scouts and the main body.

PLATE 1.

OPERATIONS OF THE 3RD PRUSSIAN ARMY,
COVERED BY THE
4TH CAVALRY DIVISION, AUGUST, 1870.

Rivers
Railways
Roads
3rd Prussian Army
4th Cavalry Division or
(The numerals are the days of the month)

SCALE
10 5 0 10 20 30 40 50
ENGLISH MILES.

and, after a short rest at daybreak, continued the pursuit the whole of the 7th, taking a large number of prisoners, one gun, and a quantity of valuable stores. The night of the 7th, the Division bivouacked as usual. Although wearied by thirty consecutive marches,[1] the first of which had been made in the burning heat of summer, they had no rest, as a violent thunderstorm raged through the night, accompanied by torrents of rain which drenched the men to the skin. Prince Albrecht bivouacked with the men.

On the 8th, the Division reached and seized the East Saverne railway, thereby securing the whole country to the foot of the Vosges. They remained in this neighbourhood until the whole of the 11th Corps had passed through the defiles of the mountains, and were then ordered again to take the lead of the army. They arrived before Marsal on the 13th accompanied by their Horse Artillery, which bombarded the fortress for some hours. During the day the place surrendered. After leaving Marsal, the Division generally preceded the army by two marches, sending forward to its own front, to a like distance of two marches,

[1] Landau was merely the rallying-point of the Division, to which the Regiments and Batteries had had to march from their different stations in Germany.

a number of small detachments with intervals of several miles between them. The great object was to discover the line of retreat and points of concentration of the different French armies, and by this means to determine the movements of the Crown Prince's army. By the restless activity of the detachments, great and small, of the Regiments of the Division, the whole country-side was disturbed and invaded, and the "Todtenköpfe," wherever they appeared, spread terror among the villagers. It was of the highest importance on these incursions to press and harass the French rear-guard, to intercept dispatches, and to make forced contributions on the villagers for supplies of forage and horses. The sorting and deciphering of the captured letters occupied, sometimes for hours, sometimes for the night, the whole strength of the Division; and on one occasion these duties proved so onerous that fifteen volunteers had to be ordered up as assistants. The information gained by this means, however, was of the greatest importance, and the point of concentration of the shattered masses of Mac-Mahon's army having been ascertained to a *certainty*, the movements of the 3rd Prussian Army were arranged accordingly.

During the advance of the Crown Prince towards Châlons, the 4th Cavalry Division led the way, with the intention of concealing the real direction of the Prussian march, and of discovering that of the French. For this object it was absolutely necessary to preserve intervals of some miles between the advanced detachments of the Division, the connection between which was preserved by an incessant interchange of mounted orderlies. For example, on one of these days, the Division extended from Bar-le-Duc on the right to Joinville on the left, a distance of twenty-two miles as the crow flies. By this extension the French were kept in a state of absolute ignorance[1] of the intentions of the Prussians, and prisoners later made declared it to be the universal belief of the French army that the Crown Prince was marching on Metz, and that the 4th Cavalry Division were his left flankers. The advanced detachments of the Division were in constant

[1] "Ignorance absolue," says the Emperor himself. "Notre action fût paralysée par l'ignorance absolue où nous restâmes toujours de l'emplacement et de la force des armées ennemies. Les Prussiens cachèrent si bien leur mouvement derrière le formidable rideau de Cavalerie qu'ils déployèrent devant eux dans toutes les directions que, malgré les plus persévérantes récherches, on ne sut jamais réelement où était le gros de leur troupes, et par conséquent où devait se produire l'effort le plus considérable."—"Des causes qui ont amené la capitulation de Sedan;" p. 11.

collision with small bodies of the French, as at Ancerville and Chevillon, where the French Cavalry had the protection of the railway from Châlons to the south as their special duty. Attacked as soon as they were sighted, the French nowhere made a determined resistance, and were driven so far back as to be unable to hold the railway.

Early on the 23rd the Light Brigade pushed forward to St. Dizier,[1] and in the afternoon of that day the rest of the Division occupied the town. On the 24th they reached Vitry, where a strong body of Gardes Mobiles, supported by Artillery, showed front. On the approach of the Division, however, they gave way, and the town, with a number of guns, was delivered up to the Germans. While the Division halted at Vitry, awaiting orders, two Squadrons of the Rhenish Dragoons reconnoitered towards Châlons. It was an important point; and the Division, as yet ignorant of the battles of Borny, Mars-la-Tour, and Gravelotte, naturally supposed it would be used as the point of concentration of the armies of MacMahon and Bazaine for a decided stand against the army of the Crown Prince. The

[1] The date in Map 1 should be 23rd, not 22nd as shown.

Dragoons, however, found the town unoccupied. Hardly had they reached Châlons, when news arrived that the Crown Prince was in full march upon the place. The Dragoons, consequently, reconnoitered towards the camp, but found it abandoned. The Division left Vitry on the 25th, and halted at Châlons that night, sending forward the Dragoons to Rheims and the Uhlans to Epernay. Some uncertainty now arose as to the movements of MacMahon. All the information collected by the Division pointed to the conclusion that he had marched towards Rheims; but as this might mean either a retreat upon Paris, or a movement towards Metz to relieve Bazaine, the flank detachments were recalled to prevent surprise.

On reaching Rheims, the town was apparently unoccupied; but it was afterwards discovered that a body of Infantry and Artillery had only left the town after the arrival of the Dragoons in it. At Epernay some Engineers threw up a field-work and induced the inhabitants to fire upon the Uhlans in the streets, for which the town was afterwards heavily fined. On the 26th the Division marched from Châlons in the direction of Vouzières, and it was now made certain that MacMahon

had abandoned his retreat on Paris, and was operating on Metz to relieve Bazaine. This important intelligence at once caused a change in the direction of the Prussian advance; for the success of MacMahon's movement meant the concentration of 100,000 French troops in rear of the armies of the Crown Prince and the Prince of Saxony. Instead of Châlons, therefore, the Prussians immediately directed their march northwards on Clermont en Argonne, and St. Menehould. Meanwhile the advance of the Uhlans to Epernay had completely deceived the French, who took the Cavalry on the right flank as an army advancing on Paris.

The Division hanging round the right flank of the enemy's march, reached Vouzières on the 28th, and on the 29th formed a junction, in the neighbourhood of Nancy, with the 5th and 6th Cavalry Divisions which covered the advance of the army of the Prince Royal of Saxony. In the desire of bringing on an engagement, the Division pressed on beyond Vouzières to Stonne, on the 30th, where they overtook the rear-guard of the enemy. The advanced guard of the Uhlans immediately attacked, and took an officer and forty men prisoners. The Heavy and Uhlan Brigades now received the order to go into cantonments, while

the Light Brigade got orders to pursue. Scarcely had they marched, however, when firing was heard in the direction of Raucourt. Prince Albrecht, who was with the advance-guard of the Light Brigade, immediately galloped "au canon," sending back orders, at the same time, to the Uhlan and Heavy Brigades to follow him at once. But darkness had set in, and the 5th Division did not reach the scene of action. Nor was their presence required. The movements of the armies of the Crown Prince and the Prince Royal of Saxony had been so skilfully planned and so admirably executed, that the relief of Metz by MacMahon was no longer possible, and the Division presently received orders to march on Sedan. Daybreak on the 31st August found them on their way thither. So dense a fog covered the country on the morning of the 31st, that even towns were not visible until the Division was in the outskirts. In many of these towns bodies of French Infantry were discovered, who were at once made prisoners. If the Uhlans did not ride them down at the first onslaught, the Dragoons and Hussars dismounted, and drove them into the streets with their carbines. Then, and conspicuously, was shown the importance of teaching cavalry how to use their

fire-arms on foot. The number of prisoners taken amply repaid the Cavalry for the long hours they had spent in peace time in practising what was then looked on as a dismal and useless duty.

When the fog lifted, the Division found themselves so close to the walls of Sedan that, to avoid Artillery fire, they were obliged to move off in a south-westerly direction. The head-quarters of the Division passed the night of the 31st on a height called Dorfe-Noyers, from which could be seen the whole valley in which Sedan lies. During the night it was thought that the French might move in the direction of Mézières; but when the morning of the 1st broke, this notion proved to have been unfounded, and the battle began. The Division fell in at 6.30 A.M. at Fresnoy and moved to a height called Donchery, between Sedan and Mézières. Here a position was found to cannonade the French at Floing, and both Batteries came into action at a range of 4500 paces. In order to give the guns the necessary elevation, it was found necessary to sink the trails in the ground. At 2.30 P.M. the Division reached a wood north of Sedan, and received orders to occupy the heights of Fleigneux, almost completely in rear of the original position of the French. To reach this

position, it was necessary to move along the course of the Meuse, between the river-bed and its high wooded banks. When the head of the column reached St. Monges, the rear being still at the farm of St. Albert, some French Cuirassiers attacked us. The Posen Uhlans met the attack by a counter-attack, dismounted nearly all the French, and in addition to disabling a number of horses, captured a staff-officer, 20 cuirassiers, and 40 horses. The Division received fresh orders at Fleigneux, where their mere presence showed the French how completely they were surrounded, to blockade the roads over the Belgian frontier and prevent any organised bodies of the enemy from retreating in that direction.

Late in the afternoon, firing being again heard near Sedan, the Division had to select their freshest horses and prepare for a renewal of the fight. After a short time, however, to the satisfaction of every one, the firing ceased and the battle ended.

On the days following the capitulation, part of the Division was employed in escorting prisoners and captured horses, a duty rendered all the more irksome by the inclemency of the weather. Although the Division had marched from Landau to Sedan almost without drawing rein, there was no

thought of rest; and on the 7th September the Light Brigade left Sedan to resume the advance on Paris. With the exception of the few days after Sedan, the 4th Division had been in contact with the enemy almost continuously since the beginning of the war. A part of it had been nearly always on outpost duty, and it had made countless reconnaissances. Completely isolated and without Infantry, it could seldom rely on the support of the main body of the army, which marched always one, and sometimes two days' march behind it. It stretched out a hand to the army, but it was only to afford protection, not to seek assistance. Relying on their own efforts, the Cavalry fought their way 40 and 50 miles in advance of the army, going everywhere, seeing everything, and avoiding no collision which offered important consequences. When the French were too strong, the Cavalry eluded their grasp; when the French were covered by insurmountable obstacles, no *détour* was too long to make in order to turn their position. The advance of the Cavalry was only checked by the necessity of maintaining uninterrupted communication with the army.[1]

[1] For some excellent remarks upon this subject, see "Militärische Gedanken u. Betrachtungen über den Deutsch-Franz. Krieg, 1870–1,"

Such were the operations of the Crown Prince's Cavalry, as related by one of themselves. It is necessary to remember, however, that these operations were undertaken against an enemy whose Cavalry had received little or no instruction in reconnoitering duties before the war. On the outbreak of the war a torrent of orders, memoranda and circulars on these duties was let loose upon the Cavalry; but as Colonel Fay plaintively says, "les circulaires ne font rien."[1] It is ridiculous to suppose that troops can perform duties in war which they have not learnt and practised in peace. "The Romans," says Josephus, "do not begin to use their weapons first in time of war. . . . As if their arms did always cling to them, they have never any truce from warlike exercises . . . and he would not be mistaken that called their exercises bloodless battles, and their battles bloody exercises." Had the French Cavalry been properly instructed in reconnoitering duties at the camp of Châlons,[2] we

by a German General; p. 79. The failure of Lee's operations in the American campaign of 1863, which culminated at Gettysburg, was owing to his ignorance of the movements and position of the Federals; Stuart, on whom Lee depended for intelligence, having got too far away from him.

[1] "Journal d'un officier de l'armée du Rhin," Lieut.-Col. Fay; p. 30 *et seq.*

[2] "It was in Châlons," says a Volunteer of the army of the Rhine, "that . . . our young officers learned the falsest notions of

should have heard little of their shortcomings in the field, and the action of the German Cavalry would have been necessarily modified, both as regards distance from the main body and lateral extension.

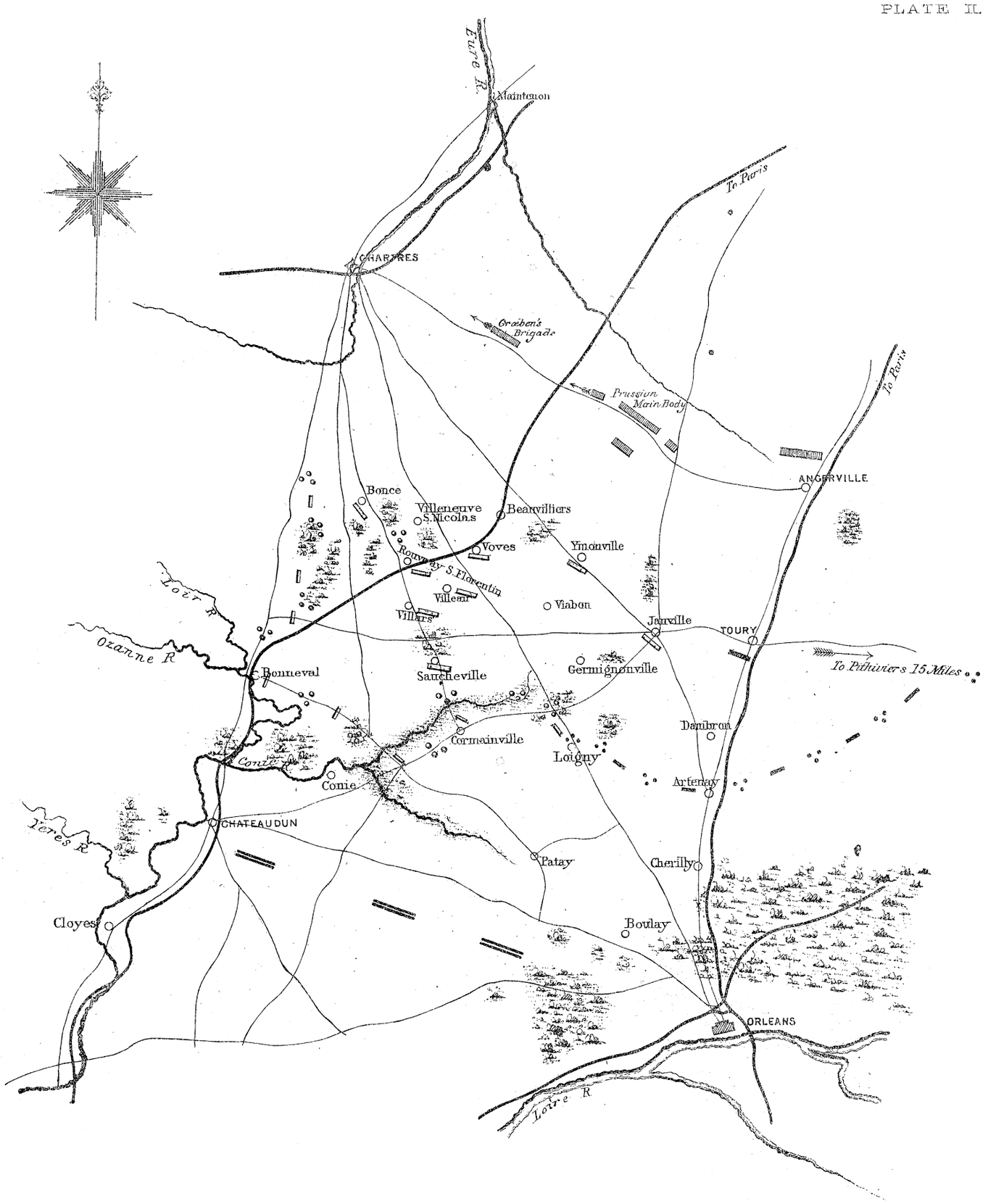
OPERATIONS OF THE DUKE OF MECKLENBOURG'S RECONNOITERING CAVALRY.

On the 12th November 1870, the Grand Duke of Mecklenbourg's Army lay between Chartres and Angerville, headquarters being at the latter place.[1] The French under D'Aurelle de Paladines were posted between Orleans and Chateaudun. For reasons it is unnecessary to give here,[2] the Grand Duke determined to concentrate his army at

what campaigning really is. It was there that the Commissariat learned how to provision troops—in a standing camp. It was there, on a peaceful parade-ground, that we became persuaded of 'the incontestable superiority' of our Field Artillery over that of the Prussians; and it was there that our Cavalry learned how to reconnoitre, by Regiments at Squadron-interval. It was there that our Generals learned how to beat an enemy once a week, between breakfast and dinner; and it was by paltry successes there that those whose advancement had been previously determined upon, were declared to have proved themselves worthy of promotion. Too many of those who led us in 1870 had won their spurs at 'le Petit-Mourmelon.'"—"Hist. de l'armée de Châlons;" p. 87 *et seq.*

[1] See Map 2.

[2] See Chanzy's "Deuxième Armée de la Loire;" pp. 34, 449.



DISPOSITION OF THE 2ND AND 4TH PRUSSIAN CAVALRY DIVISIONS
TO COVER THE
FLANK MARCH FROM ANGERVILLE TO CHARTRES, NOV. 1870.

Roads
Rivers
Railways
French Troops
Prussian main body
4th Cavalry Div.
2nd " "
Forrests

SCALE
10 5 0 10
ENGLISH MILES

Chartres, and with that object published the following orders :—

"*Orders for the 4th Cavalry Division.*

"ANGERVILLE, 12th November 1870; 11.30 P.M.

"H.R.H. having determined to march towards Chartres, under the protection of two Divisions of Cavalry, it is of importance to make the movement without attracting the attention of the French. The following orders will be obeyed :—

"1. Gröben's Brigade of Cavalry will march at daybreak to-morrow for Chartres, and on arrival there will place itself under the orders of General Schmit, Governor of Chartres.

"2. The 4th Cavalry Division, under Prince Albrecht, will clear the road leading from Janville to Chartres and camp to the south of the road. Supported by Infantry, it will reconnoitre as far as Voves and Villeneuve St. Nicolas.

"3. The 22d Infantry Division will parade at 7 A.M. and march towards Chartres. It will be quartered in the country to the west of the Tours railway and north of the road from Janville to Chartres.

"4. This Division will follow the Bavarian

corps, to which are attached Rausch's Brigade of Cavalry, and two field batteries. Cantoned to the west of the Tours railway, and the north of the road from Janville to Chartres, it will extend to the east along the line of Mondonville, Sainte Barbe, and Ouarville.

"5. The 2d Cavalry Division, under General Stolberg, will be detached from the Bavarian Corps, and will be cantoned, on the road from Orleans to Etampes, in the neighbourhood of Toury. It will reconnoitre in the direction of Orleans from Pithiviers on the east to Conie on the west.[1] The special object of this disposition is to conceal the march of the troops from the enemy.

"6. The 17th Division of Infantry will march from Angerville at 7 A.M., Stollberg's Regiment excepted, which will be in reserve, and quarter itself north of the Izé, between Gué-de-Longroy and Auneau.

"7. His Royal Highness Prince Albrecht will receive further orders at 6 o'clock P.M. at Angerville.

"(Signed) KRENSKI.

"Chief of the Staff."

[1] Nearly forty miles.

In pursuance of these orders, Prince Albrecht issued the following Divisional Orders :—

"YMONVILLE, 13th November 1870, 5 A.M.

"1. The 8th Brigade, supported by two guns of Schlotheim's Battery, will march at seven o'clock towards Loigny, and will send out strong patrols to the south and south-west. Unless prevented by the enemy, it will rejoin Hahn's Brigade at Germignonville and Viabon.

"2. The 9th Brigade, supported by four guns, will march at 7 A.M. towards Saucheville. From there, protected by strong patrols, and carefully maintaining its communication on the left with the 8th Brigade, it will advance to Bonneval by Cormainville, and the road from Chartres to Bonneval. In the afternoon it will take up its quarters at Rouvray St. Florentin, Villiers, and Villeau.

"3. The 10th Brigade and Manteuffel's Battery will march at 7 A.M., by Voves to Bonce. The Cavalry will reconnoitre the woods and villages of Bonce, and will patrol as far as the Eure northwards, and southwards until it establishes communications with the 9th Brigade. It will be quartered at Voves, Suzeray, and l'Hopiteau.

"4. I shall be at Voves at 9 A.M., where I shall establish my headquarters until to-morrow.

"5. The baggage cannot be forwarded to the new cantonment; but to ensure safety it ought to be south of the road Janville-Chartres by 7 A.M.

"6. The 9th Brigade will leave its remounts at Angerville; the 10th Brigade at Ymonville.

"7. Voves will be the rallying-point of the Division in case of attack.

"8. The Brigades will make their own arrangements for security.

"9. The ambulances will march for Voves at 8 A.M.

"10. The whole Division must estimate and supply themselves with the ammunition required for the day. The 2 Batteries should come to an understanding upon the subject. Their ammunition waggons will, according to orders, follow the 9th and 10th Brigades.

"11. Each Regiment will detail a certain number of men to take orders at the headquarters of H.R.H. the Grand Duke. These men, eight in number, will parade at Angerville.

"12. At 8 A.M. each Brigade will have an officer at Voves to receive my orders.

"(Signed) ALBRECHT."

These orders, given in General Chanzy's "Deuxième Armée de la Loire," p. 455, were taken from a German order-book found in Viabon when the Germans left, which was forwarded after the war to General Chanzy. This order-book, the General was told, belonged to Prince Albrecht. The Prince happened to be breakfasting in his shirt-sleeves at Viabon when the German Cavalry were surprised there, and he left in great haste, forgetting his order-book. Only two remarks need be made upon this story. First, Prince Albrecht never was in Viabon in his life; and secondly, the German Cavalry never were surprised there. But whatever may be the true history of the order-book, the orders possess three great merits. They are sufficient; they are clear; and they are short.

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